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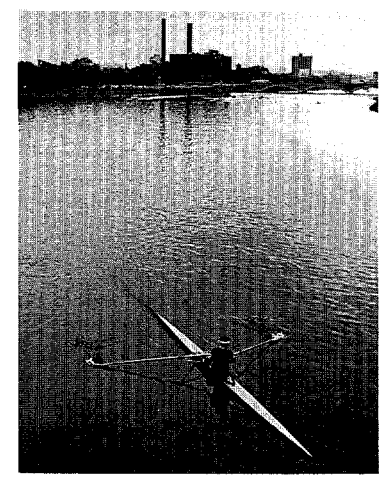
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New England River Basins Comm.

Report of the Southeastern New England Study



a Strategy for Balanced Development
and Protection of Water and Related
Land Resources in Eastern
Massachusetts and Rhode Island
**4. CAPE COD AND ISLANDS
PLANNING AREA REPORT**

**COASTAL ZONE
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New England River Basins Commission

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The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. Ipswich-North Shore,
2. Boston Metropolitan,
3. South Shore,
4. Cape Cod and the Islands,
5. Buzzards Bay,
6. Taunton,
7. Blackstone and Vicinity,
8. Pawtuxet,
9. Narragansett Bay and Block Island,
10. Pawcatuck

Other reports prepared during the course of the Study include the following:

Inventory Reports

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

Special Reports

In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops

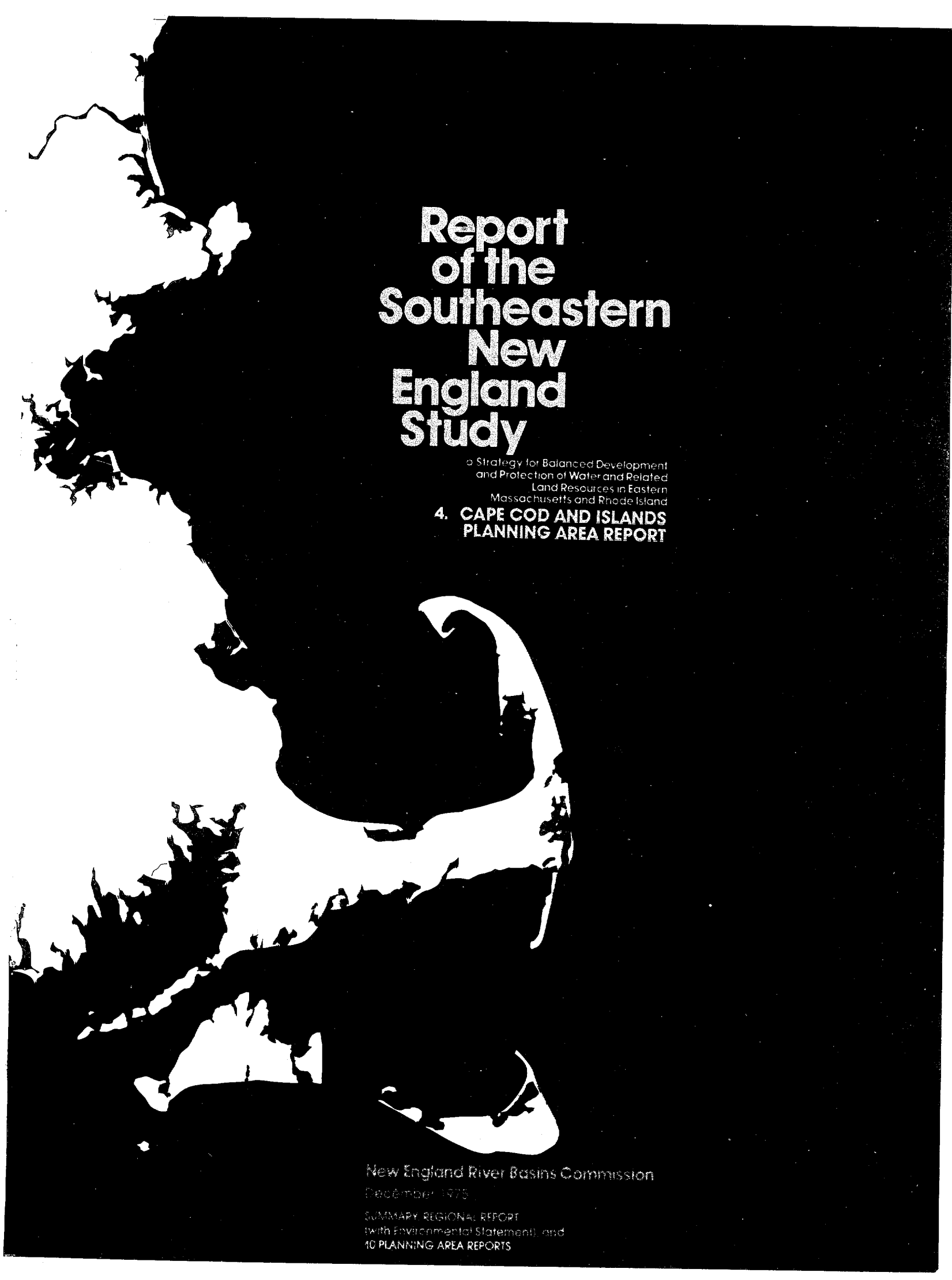
Copies of reports are available from:

New England River Basins Commission
55 Court Street
Boston, Massachusetts 02108

National Technical Information
Service
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.





Report of the Southeastern New England Study

a Strategy for Balanced Development
and Protection of Water and Related
Land Resources in Eastern
Massachusetts and Rhode Island

4. CAPE COD AND ISLANDS PLANNING AREA REPORT

New England River Basins Commission
December 1975

SUMMARY REGIONAL REPORT
(with Environmental Statement), and
10 PLANNING AREA REPORTS

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

FOR A "THUMBNAIL SKETCH"

Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

TO LEARN THE MAIN POINTS

Read the **SUMMARY**. It is published separately. You can read it in either of two ways:

- **SELECTIVELY**. Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or

- **ENTIRELY**. Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

TO UNDERSTAND THE DETAILS

Read the **REGIONAL REPORT**.

- **SELECTIVELY**. It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or

- **ENTIRELY**. Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

FOR APPLICATION TO YOUR AREA

Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

TABLE OF CONTENTS

4. Cape Cod and Islands Planning Area Report

OVERVIEW	v
PLANNING AREA ACTIONS MAP	vii
CHAPTER 1 THEMES	1-1
CHAPTER 2 THE SETTING	2-1
CHAPTER 3 GUIDING GROWTH	3-1
<i>The Situation 3-1, Anticipated Growth 3-1, Accommodating Growth 3-2, Guiding Growth 3-2, Critical Environmental Areas 3-2, Developable Areas 3-2, The Solutions 3-5, Priorities 3-8, Implications 3-8,</i>	
CHAPTER 4 WATER SUPPLY	4-1
<i>The Situation 4-1, Ground Water Supplies 4-1, The Solutions 4-1,</i>	
CHAPTER 5 WATER QUALITY	5-1
<i>The Situation 5-1, Sewer Service Considerations 5-1, The Solutions 5-2, Subsurface Disposal and Eutrophication 5-2, Water Quality and Water Supply Coordination 5-3, Disposal Methods 5-3, Regionalization 5-3, Anti-Degradation 5-5, Vessel Wastes 5-5, Landfills 5-6,</i>	
CHAPTER 6 OUTDOOR RECREATION	6-1
<i>SWIMMING 6-1, The Situation 6-1, The Solutions 6-1, SALT WATER FISHING AND RECREATIONAL BOATING 6-2, The Situation 6-2, The Solutions 6-3, GENERAL OUTDOOR RECREATION 6-5, The Situation 6-5, The Solutions 6-6, FRESH WATER FISH AND WILDLIFE 6-7, The Situation 6-7, The Solutions 6-7, Implications 6-8,</i>	
CHAPTER 7 MARINE MANAGEMENT	7-1
<i>SHELLFISH MANAGEMENT 7-1, The Situation 7-1, The Solutions 7-1,</i>	
CHAPTER 8 FLOODING AND EROSION	8-1
<i>The Situation 8-1, Inland Flooding and Erosion 8-1, Tidal Flooding and Coastal Erosion 8-1, The Solutions 8-2, Recommendations 8-3, Implications 8-4,</i>	
CHAPTER 9 LOCATING KEY FACILITIES	9-1
<i>SAND AND GRAVEL EXTRACTION 9-1, ELECTRICAL POWER 9-1.</i>	

OVERVIEW

Cape Cod and Islands Planning Area

What is the point of the SENE Study program?

Balanced use and conservation of the region's water and related land resources is the plan's objective. The South-eastern New England (SENE) Water and Related Land Resources Study was authorized and funded by Congress in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied natural resources. The SENE Study has two major goals:

- To recommend actions for all levels of government and private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced use and conservation of the region's water and related lands.
- To assemble information on the resources at a consistent scale and level of detail.

What makes this Study different is that it covers a relatively large geographic area (4400 square miles), it addresses a full range of water and related land issues, and it proposes coordinated actions for all levels of government and private interests.

What does the SENE Study program cover?

The most important recommendations for this planning area include the following:

- (1) To accommodate growth in environmentally and economically acceptable ways, municipalities should prohibit or restrict development on Critical Environmental Areas such as wetlands, flood plains, and well sites. Growth should be guided to Developable Areas, which cover 32 percent of the planning area. Within this category, municipalities should manage development of resources such as steep slopes, ledge, and soils with septic limitations. Development should be encouraged where services already exist or are planned.
- (2) To preserve Cape Cod and the Islands' fragile water supplies, municipalities on Cape Cod and

those on Martha's Vineyard should each form a water management agency. These agencies would coordinate the planning and future management of the area's water supplies. Among other things, they should regulate ground water pumping; prevent lowering of the water table below mean sea level; and monitor the rate of salt water encroachment into the fresh ground water.

- (3) To preserve the high quality of the Cape and Islands' ground water and surface water, a significant factor will be the proper disposal of wastewater. The Department of Environmental Quality Engineering and individual municipalities should review and update regulations for siting septic systems. Municipalities should redouble efforts to eliminate the causes of pond eutrophication. New, small treatment systems will have to be constructed, with consideration given to eventual land disposal of adequately treated wastewater. Finally, contamination of ground and surface water by solid waste leachate should be carefully studied.

What will the program do?

If the recommended actions are carried out, most 1990 needs for water, sewers, electric power, and outdoor recreation could be met by making more efficient use of legal authorities, and institutional designs. Protecting Critical Environmental Areas will avoid potential dangers to life and property from flooding, erosion, and contamination of water quality, and will provide highly productive greenbelts. As a result, new growth in this planning area can be accommodated without harming the high quality environment which attracted the growth in the first place.

You can take the first step in helping to carry out the actions by reading the recommendations in the SENE Study's Regional and Planning Area Reports. Write your local planning and conservation officials to encourage them to use the SENE planning process when developing or implementing master plans, zoning ordinances such as flood plain and watershed protection, and other water and land use decisions.

RECOMMENDATIONS

GUIDING GROWTH (Chapter 3)

1. Protect priority Critical Environmental Areas.
2. Restrict development on other Critical Environmental Areas.
3. Manage growth on Developable Areas.
4. Use SENE resource development capability analysis to guide future growth.
5. Accommodate growth where services already exist.

WATER SUPPLY (Chapter 4)

1. Form Cape Cod and Martha's Vineyard water management agencies.
2. Regulate ground water pumping rates to prevent salt water intrusion.
3. Recycle cooling water by on-site aquifer recharge.
4. Prevent lowering of water table below mean sea level pending hydrologic studies.
5. Prohibit ground disposal of waste materials until health effects have been fully studied.
6. Determine position of salt-fresh water transition zone in coastal aquifers.
7. Establish local building codes, subdivision regulations, and zoning ordinances to encourage stormwater recharge basins.

WATER QUALITY (Chapter 5)

1. Enforce local subsurface disposal regulations.
2. Establish local regulations to inhibit pond eutrophication.
3. Construct or expand small collection systems in 14 towns.
4. Construct three new collection systems on Nantucket.
5. Investigate five possible inter-town sewer service areas.
6. Construct small secondary plant at Cuttyhunk with pump-out facilities for visiting yachts.
7. Consider land disposal, when proven feasible.
8. Construct pump-out facilities at marinas wherever possible.
9. Study pollution of ground and surface waters by solid waste leachates.
10. Attenuate runoff from new urban development.

OUTDOOR RECREATION (Chapter 6)

Swimming

1. Consider building parking lots on Route 6 with buses to the beaches.
2. Secure public access to the shoreline.

Recreational Boating

3. Maintain, or dredge, up to ten recreation boating channels.
4. Guide future marina development.
5. Encourage fore-and-aft mooring practices in protected anchorages.

6. Construct fishing piers and boat ramps along the shoreline.

General Outdoor Recreation

7. Encourage private campground and picnic area developments.
8. Increase the number of picnic facilities at the National Seashore, as necessary.
9. Manage Critical Environmental Areas for camping, picnicking, or hiking.
10. Acquire upland natural areas.
11. Maintain Noman's Land as a wildlife preserve.
12. Construct bicycle paths.
13. Use SENE Development Capabilities Map for open space protection.

Fish and Wildlife

14. Continue wildlife management on Otis Air Force Base.
15. Use the Natural Resources Planning Program to reinforce wetlands legislation.
16. Acquire the most productive wildlife habitats.
17. Include ponds 10 acres and over in Great Ponds legislation.
18. Acquire access to the most productive fish ponds.
19. Acquire access to the most productive fish streams.

MARINE MANAGEMENT (Chapter 7)

Shellfish

1. Provide State technical assistance for local shellfish management.
2. Study aquacultural potential of estuaries.
3. Provide State assistance for local aquacultural licensing and management.
4. Consider wastewater reuse for aquacultural operations.

FLOODING AND EROSION (Chapter 8)

1. Adopt flood plain zoning to prevent adverse flood plain development.
2. Acquire significant flood plains and wetlands.
3. Locate in existing safe buildings in the flood plain.
4. Encourage natural stabilization of coastal erosion areas.

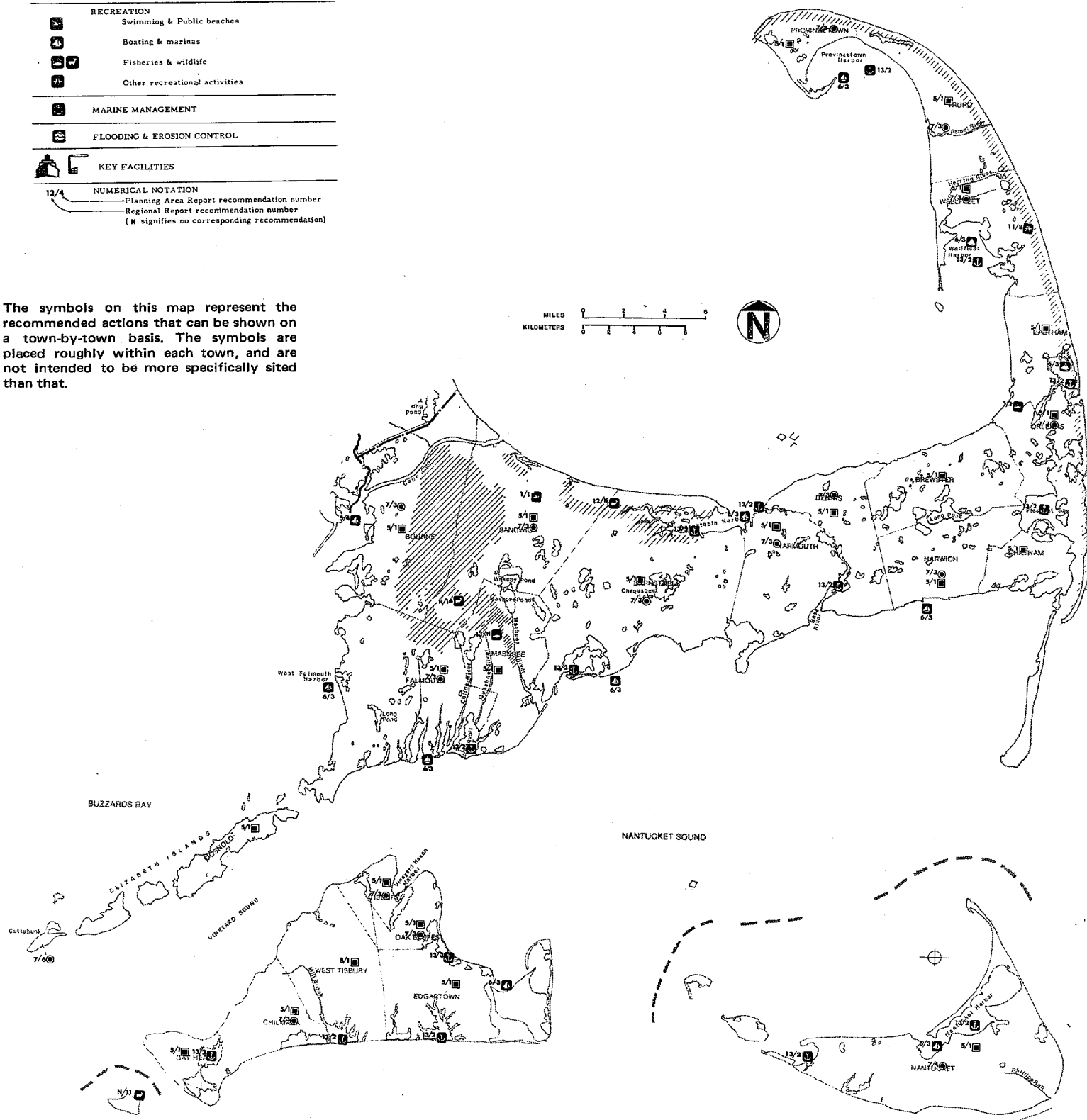
LOCATING KEY FACILITIES (Chapter 9)

See Regional Report — Chapter 9

	WATER SUPPLY
	WATER QUALITY
	RECREATION
	Swimming & Public beaches
	Boating & marinas
	Fisheries & wildlife
	Other recreational activities
	MARINE MANAGEMENT
	FLOODING & EROSION CONTROL
	KEY FACILITIES
	NUMERICAL NOTATION
	Planning Area Report recommendation number
	Regional Report recommendation number
	(M signifies no corresponding recommendation)

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Cape Cod Planning Area Recommended Actions

CHAPTER 1 THEMES

This report on the Cape Cod and Islands planning area is one component of a comprehensive program for managing water and related land resources in the Southeastern New England (SENE) region. The Study's Regional Report has presented recommended policies and actions from a regionwide or statewide perspective. This Planning Area Report includes applications of those broad-based recommendations to the communities of Cape Cod and the Islands.

One reason for preparing planning area reports is to connect the actions at the local level with the policy framework and considerations for state and federal levels. Action recommendations are made to individual municipalities in keeping with the emphasis of the SENE Study for placing decision making at the level closest to the problem, and in acknowledgement of the region's long history of local autonomy. The boundaries of the planning areas have been set along the city and town lines which most closely conform to the hydrologic boundaries of the drainage areas.

The SENE Regional Report and each of the 10 planning area reports are all linked by three common themes:

- **Enhancing the environment enhances the economy.** The region's reputation as a pleasant place to live will have to be maintained in order to attract the highly skilled workers characteristic of a service economy. This need is especially clear on the Cape and Islands, which serve not only as a regional, but a national playground for much of the country's population.
- **Anticipated growth can be accommodated, but it needs guidance.** Bisected by Route 6 and lying within a day's drive of the nation's most densely populated areas, the rapidly growing communities in this planning area have a special need to plan growth.
- **Existing knowledge, programs, and institutions provide the most realistic tools for achieving results, but some changes are needed.** Full use of ongoing programs, with some changes in how they relate to each other, was viewed as a way of "piggy-backing" on programs which have already weathered most of the realities of the political process. In choosing this strategy, the Study traded off novelty to increase achievability.

Each major chapter in this Planning Area Report suggests actions which ought to be taken in order to solve problems with continued growth or resource protection. Some of these problems are immediate, while others may not surface until after 1990 or, in some cases, the next century. The intensity of these various problems is set out in Table 1.1, which compares the severity of a given problem for each planning area, and for the region as a whole.

Of the seven problem areas studied, three have major or severe issues affecting the towns of the Cape and Islands planning area:

- **Guiding Growth.** This is the second most rapidly developing of all 10 SENE planning areas. Residential development is putting increased pressure on water and sewer service facilities and is threatening some of the area's fragile ground water resources with permanent damage.
- **Water Supply.** If the area's rate of growth continues, many of the individual communities' water suppliers may be forced to overtax their ground water reserves. These conditions would have the cumulative effect of endangering the supply of the entire Cape or the supplies of Nantucket and Martha's Vineyard.
- **Water Quality.** Potential wastewater discharges into the ground and into aesthetically and economically valuable recreational waters surrounding the Cape and Islands not only threaten the currently high quality waters with pollution, but also threaten the region's tourist-based economy. Leachate from the increasing volume of buried solid waste also degrades the ground water. In addition, the wastewaters discharged to the sea represent the loss of a potential source of recharge to ground water reserves, upon which the area is dependent for its future supply.

Other significant problems in the planning area focus on better use of the major beaches, improving public transportation, and providing adequate access for camping, picnicking, and surfing opportunities.

TABLE 1.1 GENERAL INTENSITY OF SENE WATER - RELATED PROBLEMS BY PLANNING AREA

[illegible]

CHAPTER 2 THE SETTING

The Cape Cod and Islands Planning Area, comprised of the flexed arm of the Cape, the Elizabeth Islands, as well as nearby Martha's Vineyard and Nantucket, altogether covers about 590 square miles, or about 378,000 acres. In the past decade the 23 municipalities in this planning area had the second fastest growth rate in the region. They sustain the greatest seasonal variations in population of *any* of the SENE planning areas. These extreme fluctuations, due of course to this area's role as a national recreation center, create major problems in servicing the increased numbers of people.

The 23 municipalities in the Cape Cod and Islands planning area include:

CAPE COD:			MARTHA'S VINEYARD:
Barnstable	Falmouth	Sandwich	Chilmark
Bourne	Harwich	Truro	Edgartown
Brewster	Mashpee	Wellfleet	Gay Head
Chatham	Orleans	Yarmouth	Oak Bluffs
Dennis	Provincetown		Tisbury
Eastham			West Tisbury
NANTUCKET ISLAND:			ELIZABETH ISLANDS:
Nantucket			Gosnold

The greatest asset of the Cape and Islands is the combination of coastal resources. Inland lakes and ponds are also important environmental resources on Cape Cod.

This region, formed by glacial moraines and till, has a notable lack of long rivers and large watersheds. The Herring River, longest in this planning area, is only six miles long. In all, the *combined* length of the principal streams on the Cape and Islands is only about 50 miles. On Cape Cod itself, the three longest rivers are the Herring, the Mashpee, and the Quashnet. Mill Brook, 4 miles long, is a principal stream on Martha's Vineyard, while the principal stream on Nantucket, Phillips Run, is only 2 miles in length.

Of the 584 miles of shoreline on Cape Cod and the Islands, 407 miles are classified as sandy beaches. Beaches which have been developed with recreational facilities total about 148 miles, a fact which explains the region's popularity with vacationers from all parts of the country. Coastal erosion has always been an active process in creating and modifying the eastern beaches on the outer Cape. Longshore drift carries the sand north and south to be deposited at Provincetown or on Monomoy Island. A significant portion of the remaining coastal features are made up of towering bluffs, rolling sand dunes, tidal marshes, and shallow embayments.

Cape Cod and the Islands are a national as well as a regional recreational resource. Their tremendous popularity as a tourist and vacation haven, however, threatens the very same unique values which serve to draw those tourists to the area.

The economy of Cape Cod and the Islands hinges directly on the maintenance of clean water, both at its beaches and its ponds. Yet tourism and related development is the major force behind increasing pressures on water quality. The maintenance of clean water on the Cape and the Islands is also intimately connected to the protection of water supply. Almost all of the fresh water used on the Cape and both Islands is supplied from ground water aquifers. There probably will be no alternative sources of water available. As a result, the maintenance of proper ground water recharge and preservation of water quality should have the highest priority in the planning area.

Traffic, increasing commercialism, and residential development also pose great problems, but they are not by any means insoluble. Fragile areas such as wetlands, marshes, and beaches can still be protected if action is taken soon. This might include concentration of future development in the existing corridor along Routes 6 and 28 on the Cape, restriction of automobiles on both Martha's Vineyard and Nantucket, and improvement of public transportation on the Cape.

While less than 2 percent of the SENE region's 4.8 million people, or about 107,000, are permanent residents of the Cape and Islands, population swells by at least 3 times during the summer season. This influx raises the population, normally ninth-ranked of the ten SENE planning areas, to about fourth place behind Boston, Providence, and the Ipswich-North Shore. In terms of absolute *permanent* population growth, the planning area was fourth highest in the region with an increase of 26,700 persons, or 33.5 percent, between 1960 and 1970 — 25.5 percentage points higher than the average for the region. Study projections indicate that permanent year round population could climb by another 54 percent to 165,000 by 1990. This rate of growth is second fastest of all SENE planning areas and more than 3 times that of the region as a whole. While the overall population density of 0.28 people per acre is the next lowest in SENE, the Cape and Islands increased their population by one-third between 1960 and 1970, ranking only behind the South Shore in terms of overall rate of growth.

In 1970, there were 35,300 persons working in the planning area. In absolute size it was the fourth smallest employment center in the region. The growth of 10,800 jobs during the sixties gave it the third smallest increase among all ten planning areas. As a result, only nine percent of the new jobs in the region were located in the area. Of those new planning area jobs, about 30 percent occurred in retail activities, and 35 percent of the increase was due to the development of major shopping areas in Barnstable. Services — utilities, business, as well as other medical, private education, architectural, engineering and research and development consulting

operations — also accounted for another 30 percent of new jobs in the basin. Population increase within the area resulted in demand for more public services, while government employment accounted for one out of five new jobs.

In 1969, per capita income of people employed within coastal Massachusetts as a whole averaged about \$2800 (in 1967 dollars). This is lower than the SENE-wide average of roughly \$3700, and is the lowest average income of any economic subarea within the region. While the SENE region as a whole averaged \$300 *higher* than the average national income, the coastal Massachusetts planning areas averaged \$600 *lower* than the nation. It should be noted that these figures are averages which give a relative order of magnitude to incomes of workers employed *within the entire coastal area* of Massachusetts. These figures are not meant to accurately represent the average real income of all area residents of the Cape and Islands.

Early in the Study, participants in public workshops indicated strong support for forming a regional body to coordinate water supply management on an inter-town basis and to investigate the feasibility of using spray irrigation or rapid infiltration of treated wastewater in order to recharge the Cape's ground water aquifer. They also advocated strengthening wetlands protection by increased technical assistance from both the state and local levels, improved wetlands legislation, watershed-wide agency protection, and wetland purchase with public funds. Additionally, they favored the continuance of National Park Service policies which maintain the Cape Cod National Seashore for conservation purposes, and the provision for a Cape Cod public transportation system with jitney service to the National Seashore.

Later during the 90-day review period, over 275 state, regional and municipal officials, federal agencies, and concerned citizens submitted comments on the Study's draft reports. The major comments are summarized in a Regional Report chapter, "*Review of the Report.*"

There were several major changes in the Cape Cod Planning Area Report as the result of 90-day review. Some issues related to ground water supplies and text were added to *Chapter 4*, which included discussion of conflicts between public and private water suppliers and unnatural concentrations of nitrates. A review and updating of the state's septic regulations was suggested in *Chapter 5* due to strong local concern. Future boating development was given a more cautious go-ahead in *Chapter 6*. A cove-by-cove, harbor-by-harbor study of the Cape's coastline was suggested to determine the appropriate capacity for the development of boating facilities. Measures to protect the Cape's valuable fresh water and anadromous fisheries were also

brought out. Because of conflicts with existing uses, half a dozen estuaries were deleted from the list of potential aquacultural sites in *Chapter 7*.

The preceding profile has several implications:

- (1) The variety and quality of the Cape and Islands' recreational opportunities are unequaled in the SENE region. However, the increases in tourism and temporary residents have placed great pressure not only on transportation, water supply and sewer system facilities, but on the very resources which attracted visitors in the first place.
- (2) The steady increase in permanent residents and the burgeoning summer population has created a level of demand on the Cape's only source of water supply, a huge ground water aquifer, which goes beyond the managerial capabilities of local governments. Without some form of Cape-wide management, the aquifer will be overtaxed, and both the economy and environment of the Cape could be threatened. Nantucket and Martha's Vineyard face the same potential threat and should consider similar island-wide management.
- (3) With the National Seashore, Cape Cod's coastal beaches are the most outstanding recreation resources, yet the opportunities to develop inland recreation sites have been overlooked. In addition, the Cape and Islands are a nationally prominent recreational boating center, and salt water fishing is a major recreational attraction.
- (4) The dependence of the area's tourist economy on coastal resources makes coastal flood and erosion damages, particularly to the beaches, especially important problems. Inland flooding problems are practically nonexistent, due to the numerous storage areas (ponds, lakes, and bogs) in the planning area, as well as the small, highly pervious drainage area of its streams.
- (5) Tourism and related development are increasing the pressure for use of the planning area's waters as wastewater disposal sites. Leachates from landfills and sub-surface disposal systems are posing increased threats of pond eutrophication and ground water degradation.

CHAPTER 3 GUIDING GROWTH

Between 1960 and 1970, the Cape Cod and Islands planning area had the second-fastest rate of growth of the ten areas in Southeastern New England. In fact, its population grew nearly four times faster than did that of the entire region. Most of the rapid growth has been concentrated in the suburban and commercial band which is spreading along the south coast of Cape Cod. This suburban sprawl caused population to jump by more than 30 percent from 80,000 in 1960 to the 107,000 of 1970, while the SENE region as a whole increased only 8 percent during the same period. Based on these trends, it is expected that the Cape and Islands could continue to be the second-fastest growing SENE planning area, increasing its population by half by 1990, and reaching a population of as much as 251,000 by 2020.

This rapid growth is creating major changes in the coastal land use character of Cape Cod, Martha's Vineyard, and Nantucket Island. Amounts of urbanized land have increased more than 40 percent. Despite this marked increase, more than 65 percent of the land area remains as wetlands, forest, and park or recreation areas, although these lands are coming under increasingly heavy development pressures. About 49 percent, or about 122,000 acres, of the remaining unurbanized land is suitable for some sort of urbanized use.

However, the Cape and the Islands sit directly atop large aquifers, their only major source of water supply. Since nearly *all* this planning area's land surface acts as a recharge to those aquifers, careful consideration must be given to the use of that land. Therefore, because the Cape and Islands are expected to have the second-highest pressure for growth in all the SENE region, there is a critical need for coordinated land use and water supply planning (see *Chapter 4, Water Supply*). Local planning boards, boards of health, and appeals boards will be hard-pressed to accommodate all proposals for sub-divisions and other types of development. Favorable response to all such projects will be increasingly difficult

without causing further environmental degradation, especially to the planning area's fragile aquifer.

There is a growing concern among local residents that future development be located in such a way which lessens the conflicts with remaining land and water resources. As pointed out in *Chapter 2 of the Regional Report*, these resources contribute greatly to the region's quality of life and its economic competitive standing with other areas in the nation. If proper planning steps are taken, much can be done to ensure that this quality of life will continue. This chapter describes current land use trends on Cape Cod and both the Islands, and the capabilities of the resources to accommodate future growth. It concludes with recommended strategies for guiding growth in an economically and environmentally sound manner.

The Situation

Anticipated Growth

As previously mentioned, the Cape Cod and Islands planning area is one of the lowest-density, yet fastest-growing of all SENE planning areas. The landscape is peppered with ponds, coastal flood plains, and tidal marshes, some of which are under intense pressure for filling and development. The area's high-quality waters have begun to show signs of increasing pollution as a result of this development; this despite the fact that the amount of land which has been urbanized, some 15 percent as of 1970, is only fourth largest of the ten SENE planning areas. (See Table 3.1)

The rates at which parts of the planning area will be urbanized will vary to some extent with relative development pressures. These pressures were estimated for SENE communities on the basis of a formula using factors such as the rate of growth of residential, commercial, and other uses, the relative accessibility of an area to employment and pop-

TABLE 3.1 MUNICIPALITY BY DEVELOPMENT PRESSURE: CAPE COD AND ISLANDS PLANNING AREA

High	Medium-High	Medium-Low	Low	
Barnstable Dennis Yarmouth	Eastham Falmouth	Chatham Harwich Mashpee Orleans Sandwich	Bourne Brewster Provincetown Truro Wellfleet	ISLANDS Chilmark Edgartown Gay Head Gosnold Nantucket Oak Bluffs Tisbury West Tisbury

Note: Communities are grouped into levels of development pressure relative to other communities in the Study region and do not necessarily reflect local building activity.

ulation in other parts of the region, and the availability of easily developable land. The precise process for grouping towns by development pressure is described in *Chapter 3 in the Regional Report*. While use of other factors, such as recent building permits or land consumption rates, may produce different results, combining the factors used gives some useful indication of development pressure in the communities in the planning area, relative to all SENE communities. Table 3.1 shows the development pressure for the planning area cities and towns.

Accommodating Growth

In 1970, about 15 percent of the total land area of the Cape and Islands was devoted to urban uses — housing, industry, schools, commercial, etc. Population and employment growth during the decade resulted in an increase in urban development of 17,000 acres, or almost 43 percent — from 39,000 acres in 1960 to 56,000 acres in 1970. For every increase of 1.6 persons, one acre of urbanized land was converted to some form of urban use during the sixties. Of the land which is urban, about 68 percent is devoted to high intensity use such as commercial, high density residential, multi-family or apartment units, industry or transportation uses. Medium-intensity uses, such as ½ acre to 1 acre residential lots, occupy about 25 percent of the urbanized area, while low intensity development (lots greater than an acre) takes up about 7 percent of the urbanized area.

If the urban land consumption rate of one acre for every increase of 1.6 persons should continue to 1990 and 2020, an estimated 58,000 acres of land would be converted to urban uses by 1990 and another 86,000 acres of urban land would be needed during the last 30 years of the forecast period. Thus, by 2020, the population would require a total of 200,000 acres of urban land, or 59 percent of the basin planning area's total land acreage.

As mentioned, the SENE Study inventory of land resources has identified only 122,000 acres that are suitable for future development. Such an identification was accomplished by mapping surface water, high yield ground water areas, wetlands, flood plains, soils suitable for septic systems, steep slopes, wildlife habitat, and important natural areas, among others. The mapped information was then overlaid and the most Critical Environmental Areas were identified. On the basis of the amount of land suitable for development and the past land consumption rate, an estimate was made of the size of population that the planning area could accommodate.

The results of this process indicate that there is enough suitable land to accommodate growth through 1990. However, these suitable lands may not necessarily be located where the pressures for growth are highest. As a result, the more critical resources (those lands which, due to their intrinsic suitabilities, ought not be heavily developed) have been identified to provide guidance for local, regional, and

state land use planners. This approach was taken so that initiative could remain at the local level for guiding development to suitable sites, while providing backup material for continued and strengthened protection of critical water and related land resources.

Guiding Growth

To properly assess the methods for guiding future growth based upon the region's water and related land resources, these resources were singled out and individually inventoried and mapped, as previously noted. Based upon each resource's intrinsic values and on existing or proposed legislative guidelines, those with similar characteristics were grouped into broad categories.

Table 3.2 presents the various types of land uses, among which are the three major resource types: categories A, B, and C. Two of these, categories A and B, are classified as **Critical Environmental Areas**.

The most fragile and valuable of these are **Priority Protection Areas (Category A)**, in which any development threatens public health, safety, and welfare: water bodies, wetlands, well sites, beaches, critical erosion areas, estuaries, shellfish flats, and fish spawning areas. **Other Protection Areas (Category B)**, which can retain their usefulness only under certain kinds of limited development, are: flood plains, prime agricultural soils, unique natural and cultural sites, proposed reservoir sites, and upland erosion areas.

The remaining unurbanized lands must be managed with varying degrees of regulation to protect certain values. These have been mapped on Plate 2 as **Developable Areas** requiring management (Categories C, F, and G) and include: ground water recharge areas, best upland wildlife habitat, high landscape quality areas, ledge and steep slope, severe septic system limitations (Category C) and moderate to no septic system limitations (Categories F and G). Use of remaining lands (Categories D and E) is generally preempted by development of the public ownership. But it is worth noting that some of the developed areas can be used — and further, that use and reuse of such land can be highly efficient.

These land and water resources have been mapped for the Cape and Islands planning area on Plate 2, where they have been combined with the resources of other planning areas in the southeastern Massachusetts subregion. The relative amounts of Critical Environmental Areas in Categories A and B, Developable Areas in Categories C, F, and G, and developed or Preempted lands in Categories D and E, are displayed for the ten SENE planning areas on Table 3.3. Table 3.4 presents suggested guidelines for the suitable uses of the Developable Areas shown on Plate 2. Plate 2 depicts regional perspective and should not be used for site design work. More accurate information, for example, is being developed on the Islands of Nantucket and Martha's Vineyard and those maps should be consulted for detailed planning.

Critical Environmental Areas comprise about 33 percent of the Cape and Islands' total land and water area of 378,000 acres. This is only slightly higher than the regional average of 31 percent, and equals about 125,000 acres of combined A and B resource types.

Category A – Priority Protection Areas, cover about 10 percent of the planning area. The diversity of these resources will be examined further in the following chapters of this planning area report, but as noted above, they combine to significantly enhance the quality of life available on the islands of Nantucket and Martha's Vineyard, as well as on

Cape Cod. Although most of these resource types are fairly evenly distributed throughout the area, the communities of Falmouth, Mashpee, Barnstable, Yarmouth, and Brewster have the majority of the area's lakes and ponds.

Interestingly, the approximately 15,000 acres of coastal wetlands seem to have survived the previous decade remarkably intact, and are very close to their 1960 total acreage. *Chapters 6 and 8* discuss the values of wetlands as storm buffers, fisheries habitats, and for other social and environmental benefits.

TABLE 3.2 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]

Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.

Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

WATER RESOURCE LIMITATIONS

Aquifers and/or Recharge Areas (Category C₁) black dots: highest yield aquifers in each basin.

WILDLIFE AND SCENIC RESOURCE LIMITATIONS

Wildlife Habitat (Category C₃), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].

Landscape Quality Areas (Category C₂), black vertical lines: land characterized by high landscape quality other than categories C₁ and C₃.

SOILS RESOURCE LIMITATIONS

Ledge and/or Steep Slope (Category C₅), brown: land with slope greater than 15 percent and/or with rock near the surface.

Severe Septic System Limitations (Category C₄), orange: land with severe septic system limitations other than Category C₅.

Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential^{5/} institutional, commercial and industrial development.

Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

Notes:

- 1/ All categories above, except those within brackets, are depicted on the development capabilities maps (plates 1, 2, 3).
- 2/ Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.
- 3/ All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.
- 4/ Categories C₁, C₂ and C₃ overlap with categories C₄, C₅, F, or G. Thus, Category C₃-C₄ is a wildlife habitat located on ledge or steep slopes.
- 5/ Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

Another 23 percent of the planning area is covered by **Category B – Other Protection Areas** not already included in Category A resources. While the Cape and Islands have few inland flood plains, they do have extensive coastal flood plains. These are critical due to the extreme hazard posed by storm flooding by hurricanes, especially to houses which may have been built in these areas. Some of the highest land use densities in the planning area can be found along the South Cape beaches in the towns of Falmouth, Mashpee, Barnstable, Yarmouth, Dennis, Harwich, and Chatham (see Chapter 8, *Flooding and Erosion, in this report*).

Developable Areas, Categories C, F, and G include land with slopes of over 15 percent gradient, which are scattered throughout the area. Improper construction can cause risk of soil erosion, undermining of foundation walls, and septic system seepage to areas downslope. High density development on soils with severe limitations for septic tank systems must be regulated to prevent health hazards, or must be provided with sewer service. Developable lands make up 32 percent of the remaining unurbanized area. If land development continues at its present rate of 0.6 acre per person (or 1 acre per 1.6 persons), there are suitable developable lands to handle growth through 2020. Assuming a continuation of present growth rates and zoning controls, the planning area's remaining capacity for development is 203,000 additional people, while the projections predict only a 144,000 increase. This should not imply that little management is necessary – precisely the opposite – protection, control, and management of all lands on the Cape by local agencies will be necessary because of the importance of ground water. Guidelines are suggested under recommendation number 3.

In addition to decisions about guiding future residential and

concomitant commercial growth to proper sites in the area, the Cape is confronted with several problems at a regional level. Large-scale **key facilities** and developments of more than local concern are sited here, sustaining the economic growth of the SENE region and servicing the needs of the population as a whole. Unfortunately, activities such as power plant operations can have locally significant adverse impacts upon water and related land resources.

The demands from industrial and domestic users for power are steadily growing, but few sites exist that meet requirements for power plants with minimal environmental depredation and pose minimal safety hazards. The Canal Electric power plant is one of the few such facilities that meets most land use criteria. Power plant siting considerations are discussed further in Chapter 9, *Locating Key Facilities*, both in this report and in the SENE Regional Report.

The need for improved and coordinated planning is of special importance to the Cape and Islands, an area which must be regarded as both a nationally and regionally unique resource. Its beaches, cliffs, waterfront, low-lying pine growth, inland ponds, and dunes provide an environment that is scarce elsewhere in the United States. This environment has both physical and economic assets which ill-conceived growth can destroy forever. The potential for improved accessibility, as the result of improving Route I-495 and I-195, will soon become reality, making populated areas relatively much closer. That improved access will make it easier for population growth to continue. It will also make it easier for a continued increase in the tourist population, whose demands for recreational facilities pose additional requirements upon municipal service systems. The Cape and Islands need protection if their environmental and economic

TABLE 3.3 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area				
		Critical Environmental Areas			Develop- able Areas	Preempted Use Areas
		A	B	A & B	C, F, G	D, E
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

assets are to continue their important regional and national function for recreation.

The balance between environmental protection and opportunities for growth required for the Cape is even more difficult than in the more urbanized areas of the region. Accommodation of year-round growth will be difficult enough, but in this planning area it is also necessary to accommodate the constantly growing summer population.

Related to this kind of growth are the following additional issues (identified by the Cape Cod Regional Transportation Committee):

- (1) Most of the Cape's growth has occurred in upper and mid-Cape communities. Many of the newcomers are older, retired persons who will eventually require the provision of special public services.
- (2) In the summer, the Cape's population is at least three times its year-round population, and is increasing.
- (3) The automobile, as the dominant means of transportation for summer people, creates problems of congestion, storage, contamination of ground and surface water from runoff, as well as aesthetic degradation.
- (4) Many retired persons, who would not otherwise use the automobile, are forced to do so because of the lack of public transit.
- (5) The normal demand for water increases by two and a half times on a summer day when tourist population is at its highest.

The Solutions

To take advantage of the Cape Cod and Islands planning area's potential for accommodating growth without significantly changing the overall quality of the environment, a three-part program is recommended for the local level: (1) Protect SENE Category A Critical Environmental Resources; (2) Restrict development on Category B Critical Environmental Resources; and (3) Manage growth on developable Category C, F, and G resources, while guiding growth to areas with existing infrastructure.

Several methods exist for protecting the fragile or critical resources listed in Table 3.2. These include existing legislation, zoning, building codes, subdivision regulations, purchase of easements, or transfer of development rights.

Within the context of these available methods for preserving

critical resources, the following action is recommended:

- 1. Protect priority Critical Environmental Areas.** Municipalities should prohibit urban development on Critical Environmental Category A Resources (Priority Protection Areas). The appropriate uses of these resources include water supply, fisheries and shellfish production, low-intensity recreation, and scenic or open space lands.

Local planning boards and conservation commissions should protect **water bodies** from pollution by restricting adjacent development and by enacting specialized subdivision regulations which require stormwater detention ponds where feasible. *Chapter 5* of this report also makes recommendations which will help to achieve the state's water quality standards. **Tidal estuaries and shellfish flats** should be protected by prohibiting outfalls of polluting effluents, and by restricting dredging, filling, or installation of pipelines. It should be understood that knowledge of coastal nursery areas is lacking and that additional research is necessary. **Wetlands** should be protected through more vigorous enforcement of existing legislation by both state and local officials (see *Chapter 6* for local assistance suggestions and *Chapter 8* for legislative improvements).

Municipalities, using Massachusetts Self-Help Funds, and private groups such as Audubon and Trustees of Reservations, could acquire the more valuable wetlands for wildlife or natural areas habitat along with their surrounding uplands as listed in *Chapter 6*. **Beaches and critical erosion areas** should be protected by zoning ordinances and selective purchase to avoid incompatible urban development, as mentioned in *Chapters 6 and 8*.

A similar recommendation is made for the management of Category B Critical Environmental Areas needing protection:

- 2. Restrict development on other Critical Environmental Areas.** Municipalities should restrict development on Critical Environmental Category B Resources (Other Protection Areas). Suitable uses to be considered for this category should include agriculture, extensive recreation, forestry, or in some cases with proper management, very low density residential use.

Measures for protecting **flood plains**, described in depth in *Chapter 8 of the Regional Report*, include local flood plain zoning which prohibits adverse development, discouraging or prohibiting reconstruction after substantial storm damages, and relocating some public facilities if structural protection is not practical. Structural methods required to remedy

flooding problems in this planning area are described in *Chapter 8* of this report. **Prime agricultural lands** should be protected by legislation enabling tax incentives, agricultural districts and acquisition of development rights for the highest priority lands. (*See Regional Report, Chapter 3, for more details.*)

Unique natural and cultural sites should be protected by acquisition, easements, or development rights. **Upland erosion areas** should be protected by local sediment and erosion control ordinances (*discussed in Chapter 8 of the Regional Report*).

The nearly 244,000 acres of Developable Areas (Category C, F, and G resources) require some management to retain the intrinsic natural functions which these resources perform. Therefore municipalities should:

3. **Manage growth on Developable Areas.**
Municipalities should manage growth on Category C resources and encourage growth on Category F and G resources, especially where infrastructure exists or is planned.

It is worth noting that this recommendation deals with management of all developable areas, both within existing developed areas, and in areas yet to be developed. There are no developable areas in which management of some kind is not required.

On **ground water recharge areas**, communities should restrict housing densities so that septic systems will not endanger ground water quality. Densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of recharge maintenance techniques to prevent depletion of the aquifer. For details about development standards, refer to Table 3.4. *Also see Chapter 4 Water Supply, and Chapter 5, Water Quality in the Regional Report.* Other ordinances and building codes should control coverage by impermeable surfaces, and require stormwater detention basins to return runoff to ground water from roofs, streets, parking lots, and driveways. Land use regulations and sound engineering practices should be used to minimize the effects of activities hazardous to ground water quality such as sanitary landfill operation, highway deicing salt storage, industrial waste disposal, agricultural runoff, and sand and gravel mining below the water table. On areas with **high landscape quality, best upland wildlife habitat, and unsewered soils with severe septic tank limitations**, only development of very low density or in clusters should be allowed. Development that would tend to preempt the resource value of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account. **Steep slopes** should be protected from erosion by zoning for low density use or with strict regulation for higher density uses. Development on **moderate limitation areas** should be

regulated to correspond to the availability of sewers. Higher densities should be encouraged on F and G lands.

Although many local governments have the authority to implement the concept of guiding growth based on resource capability, its implementation will be most effective if adopted as a matter of state policy. This is not only because the resources extend beyond town boundaries, but also because additional funds and expertise exist at the state level. The most expedient way for the state to implement these concepts would be for its interagency policy council to review and adopt, as appropriate, the policy issues suggested in this report.

Rhode Island has taken a powerful step in this direction by putting together a comprehensive land use plan. Massachusetts should continue its progress toward developing a comprehensive policy for guiding growth. This decision is most appropriately made by an interdisciplinary organization. It is recommended that the Commonwealth of Massachusetts should:




4. **Use SENE resource development capability analysis to guide future growth.**
The Massachusetts Cabinet, with the active participation of regional planning agencies and municipal governments, should review and use as a first step the SENE Study's development capability analysis to develop a policy for guiding future growth. Guidelines can be developed at the state, regional, or local level of government. (*See Chapter 10 of the SENE Regional Report*).

Chapter 3 in the Regional Report describes the economic inefficiencies and environmental costs of urban sprawl. Making better use of roads, sewer systems and water supply systems, where they already exist, could help to avert those costs. Therefore, it is recommended that policies be developed to:

5. **Accommodate growth where services already exist.** The Massachusetts Cabinet, in conjunction with municipalities, regional planning agencies, and state agencies, should establish policies to accommodate further development in already developed areas, and to permit maximum use of existing water, sewer, and transportation services. Planned unit development and the cluster principle should also be encouraged in these areas.

The *Regional Report* also recommends establishment of a system for determining criteria for locations of developments of regional impact. This would be within the framework of the system designed to protect critical areas and manage others, and would enable consideration of environmental and economic justification of siting decisions.

TABLE 3.4 SUGGESTED* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP COLOR	MAP PATTERN	NONE (color only)			
	Other Resource Limitations Soils Limitations	No other Resource Limitations	High Landscape Quality (Category C ₂)	Upland Wildlife Habitat (Category C ₃)	Aquifer and/or Ground water recharge areas (Category C ₁)
YELLOW	Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE	Severe septic system limitations caused by conditions other than slope and ledge soils (Category C ₄)	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN	Ledge and/or steep slope greater than 15% (Category C ₅)	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

** In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

*** Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering - refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System

Res. - Residential

PS - Public Sewer System

ac - acre

I/C - Industry/Commercial

DU - Dwelling Unit

Power plant siting problems in this planning area would be under its jurisdiction. Details of this recommendation can be found in the *Locating Key Facilities chapters of this report and the Regional Report, and the Guiding Growth and Strengthening the Management System for Natural Resources chapters of the Regional Report. Consistent with siting criteria suggested for other facilities of regional impact, state planning officials should give special consideration to avoiding critical resources (Categories A and B) and using limited developable resources (C, F, and G).*

In addition, the Cape Cod Joint Regional Transportation Committee should adopt, as part of its next year's work program, a study to deal with intra-Cape and the Islands' transportation needs. The Committee should consider the following suggestions:

- The use of high automobile fees for seasonal tourists or a ban on non-local automobiles on Martha's Vineyard and Nantucket (the "Bermuda Plan") in conjunction with increased development of bike trails, and bus or public taxi service.
- Provision of a mass transit system on Cape Cod including reinstatement of rail service from Boston to the Cape, and a bus system in the Seashore area. Also the increase of bike trails to improve access, increase mobility, maximize outdoor recreational opportunities, and reduce adverse environmental effects of traffic congestion and highway construction.
- The use of devices, such as tolls, to encourage use of public transportation on Cape Cod, once transit alternatives are available.
- Designation of Route 6—A as an historic district from Sandwich to Eastham, Mass.

Priorities

While the Study encourages all municipalities to undertake this development strategy, the need is especially urgent in those towns with proportionately higher amounts of Critical Environmental Areas which will be under increasing development pressure. Based on the discussion in The Situation section, these municipalities are: Barnstable, Dennis, Yarmouth, Eastham, and Falmouth.

Implications

The impact of these recommendations on development patterns in the planning area, considering the amount of area in each category and the projected population, should be significant. Application of the SENE Study's recommendations in the Cape and Islands communities can make an important difference in trying to ensure that the area continues to be an attractive place to live, work, and spend leisure time. It will currently have the effect of preserving existing and future water supplies, improving water pollution problems, and reducing coastal and inland flooding damages.

Although Category A and B Critical Environmental Areas comprise 125,000 acres and 33 percent of the planning area, there is adequate area left for future development. In fact, most, if not all, of the growth anticipated over the next years can be accommodated on lands capable of sustaining that development with minimum environmental costs.

Given present rates of land consumption, the 122,000 acres of Developable Areas will be used up shortly after 1990. This means that one of three things may happen: (1) the land consumption rate may have to change, increasing densities in some areas while ensuring protection of critical resources; (2) some of the growth will be displaced to other areas in the SENE region; or (3) some of the growth will encroach on some of the Critical Environmental Areas.

The approach recommended in this chapter emphasizes the importance of assessing the full range of environmental and economic costs which should be considered when making development decisions. Most importantly, this process shows how the cost of development to the taxpayer can be decreased while degradation of the planning area's fragile natural resources can be prevented at the same time. While the SENE Study is not a comprehensive land use plan, the preceding recommendations represent the key steps that land use planners can take to guide the region's future growth.

CHAPTER 4 WATER SUPPLY

The Situation

Nothing is more important to the economy of Cape Cod, Martha's Vineyard, Nantucket, and the Elizabeth Islands than the maintenance of high quality water, both salt and fresh. Tourism and related development, so vital to the area's economy, are dependent on a high quality marine and fresh water environment. Yet these are the very forces which are threatening the quality of the waters of the Cape and Islands. This is especially true in the summer months, when population swells to over three times the number of permanent residents.

Ground Water Supplies

Virtually all of the fresh water used on the Cape and both Islands is supplied from large ground water aquifers underlying much of the peninsula, Nantucket, and portions of Martha's Vineyard. It seems clear that, at least until 1990, no alternative sources of water will be available. Consequently, the maintenance of ground water recharge and the preservation of the quality of the aquifer are the primary resource management objectives in the planning area. In addition, it is important to consider the institutional aspects of ground water supply as well. Future conflicts which may arise between public and private water suppliers should be anticipated in order to prevent water supply problems.

To understand the nature and scope of the Cape and Islands' water supply problems, it is useful to understand the behavior of the aquifer. The ground water supply is constantly recharged from the land surface and discharged to the sea at the edge of the aquifer. A transition zone exists between the fresh water and salt water which shifts in response to variations in the rate of flow of fresh water to the sea. Thus, decreased recharge or, more importantly, excessive pumpage, can cause a landward and upward encroachment of the salt water, resulting in eventual salt water contamination of wells. One of the highest management priorities on the Cape is to control and limit salt water encroachment in the aquifer, either by regulating pumpage, augmenting recharge, or a combination of the two.

Deterioration of ground water quality from sources other than the sea is another serious threat on Cape Cod, Martha's Vineyard, and Nantucket. Because of the rapidly increasing population on Cape Cod, both solid waste and wastewater have also increased, and the disposal of these wastes can have a serious negative impact on ground water quality.

Leachate formed by rain water percolating downward

through solid waste disposal sites can become highly concentrated with dissolved solids of particularly noxious character and can contaminate ground water. In addition, much domestic wastewater is discharged to the ground through cesspools, septic tanks, and seepage fields. While many of the suspended solids contained in this wastewater are filtered out as the water percolates through the ground, many dissolved contaminants may be carried long distances. Wastewater, therefore, deteriorates ground water quality, particularly near the disposal sites. A recent study by the Water Resources Research Center of the University of Massachusetts has noted nitrate concentrations in excess of natural levels in selected, highly developed areas. Although this problem is presently a local one, the importance of preserving high ground water quality cannot be overemphasized.

A common solution to the domestic waste disposal problem is municipal sewerage. Sewering alleviates surface seepage and its threat to health and the threat to ground water quality. However, although it solves some local ground water pollution problems, sewerage creates a municipal problem with large scale disposal of wastewater. The wastewater can be treated to achieve various levels of quality and can then be discharged into the ocean, returned to the ground through filter beds, or recycled by spray irrigation. When wastewater is disposed through cesspools and septic systems, water is recycled to the aquifer. Because of this return flow, the disposal of ground water supplies through septic systems may result in a net artificial discharge of only about 25 percent from the system.

When an area is sewered to an ocean outfall, however, none of the water is returned to the aquifer, and the net loss is 100 percent of the ground water pumpage. An ocean outfall would therefore cause a greater decrease in ground water availability than an on-land method of disposal. In addition, an ocean outfall might have a degrading effect on the ocean's ecosystem, affecting fisheries and recreational resources — the most important economic assets of Cape Cod and the Islands — as well as on the entire coastal ecosystem of this planning area.

The Solutions

To date, a strategy of independent water district management has proved successful because the Cape's aquifer has been large enough to support the demands placed upon it. However, the steady increase of permanent residents and the significant increases in tourism and temporary residents have created a level of demand on the aquifer which requires Cape-wide planning and management. Without such manage-

ment, ground water may become contaminated or depleted, and the economy and environment of the Cape may be seriously impaired. There are currently no feasible alternative supplies for the Cape and Islands. Some natural ponds on Cape Cod could be used for water supply (Falmouth uses Long Pond), but in general, soil conditions on the Cape and Islands are not favorable for developing surface water reservoirs. The following actions are therefore recommended:

1. Form Cape Cod and Martha's Vineyard water management agencies. The towns on Cape Cod should consider forming a Cape Cod Water Agency, while the towns of Gay Head, Chilmark, West Tisbury, Tisbury, Oak Bluffs, and Edgartown should also consider forming a Martha's Vineyard Water Agency. Such agencies could be seated in: (a) a regional planning and development group with local government representation; (b) a regional association of local governments; or (c) a regional division of the state water supply commission. Such a regional water agency should provide the decision making capacity for regional planning and management of water supplies and be able to implement these activities. It should integrate and evaluate the multiple effects of development and management activities, and should coordinate these activities, in order to achieve planning and management objectives. It should obtain the hydrologic expertise necessary to analyze its needs and opportunities and should design the solutions necessary to achieve its goals and objectives.

Responsibilities of a regional water management agency for Cape Cod include:

- (1) Inventory of withdrawal facilities, waste disposal sites and conditions, water development and waste disposal plans, and ground water related problems.
- (2) Measurement and physical description of hydrologic conditions, including the water table and its seasonal variation, hydraulic conductivity, storage coefficient, hydrologic boundaries, water quality, and salt-fresh water transition zones.
- (3) Development of conceptual and physical or mathematical models to be used as tools for predicting effects of various development and operating schemes.
- (4) Determination of water-interrelated environmental impact limits for environmental characteristics sensitive to ground water use.
- (5) Development of plans for allocation of resources based on physical hydrologic conditions and en-

vironmental impact limits.

- (6) Encouragement of further interconnections between individual municipalities' water supply systems to meet peak demands. Sharing water at these times will reduce the intensity of the peak demands on the aquifer and will result in more efficient ground water use.
- (7) Management of ground water reservoirs: design of future water withdrawal and waste disposal site distribution alternatives. Investigation, design, and regulation of well field operations.
- (8) Presentation of the alternative plans and strategies for achieving goals of the region for public information, evaluation, and education.

The elements presented above are not necessarily in order of priority. Most of them are interdependent efforts requiring continuing pursuit.

A recent referendum in Barnstable County has authorized the Barnstable County Commissioners to fund a ground water resources study of Cape Cod. The study, by the U.S. Geological Survey and jointly financed by Barnstable County, the divisions of Water Resources and Water Pollution Control of the State's Water Resources Commission, the National Park Service, and the U. S. Geological Survey, is now underway. A similar ground water study of Nantucket has begun, and a study of Martha's Vineyard is scheduled to begin soon. If adopted, these studies can provide a firm basis for the implementation of the recommended ground water management in the Cape and Islands planning area. The programs can help to ensure the continued supply of high quality water for Cape Cod and the Islands. Moreover, the coordinated planning of the Water Resources Commission and the expertise of the U.S. Geological Survey will greatly benefit the planning area communities, which will be able to rely on this economical source of supply to its maximum extent.

Examples of ground water management actions which may be undertaken by a regional water agency or commission, or voluntarily by municipalities after necessary legal authority is provided, include:

2. Regulate ground water pumping rates to prevent salt water intrusion. Municipalities or a water management agency should require renewable annual permits for any ground water pumpage in excess of 50,000 gallons per day from any area of one acre or less. Regulate total withdrawal from one

square mile areas to prevent salt water intrusion to public and private ground water supplies.

3. Recycle cooling water by on-site aquifer recharge. Municipalities or a water management agency should require that all ground water pumpage in excess of 50,000 gallons per day for cooling purposes be returned to the ground on the same property from which it was withdrawn.
4. Prevent lowering of water table below mean sea level pending hydrologic studies. Municipalities or a water management agency should allow no drawdown of the water table to a level below mean sea level for any period of time, or for any reason, without prior hydrologic study which demonstrates that no impairment of ground water quality or the environment will result.
5. Prohibit ground disposal of waste materials until health effects have been fully studied. Municipalities or a water management agency should allow no additional injection, spraying, or other discharge of any waste material to the ground without careful investigation of the health effects of such action. They should also require a complete description of the limits of the resultant aquifer contamination anticipated, both horizontal and vertical.
6. Determine position of salt-fresh water transition zone in coastal aquifers. Mu-

nicipalities or a water management agency, working with appropriate state and federal agencies, should determine the position of the salt-fresh water transition zone in coastal aquifers through a drilling and sampling program, and should establish a monitoring network to measure the rate of salt water encroachment.

7. Establish local building codes, subdivision regulations, and zoning ordinances to encourage stormwater recharge basins. Municipalities should establish policies that encourage discharge of stormwater from newly developing areas to inground recharge basins to maintain aquifer recharge. This does not apply to the northwestern portion of Martha's Vineyard where hydrogeologic conditions are unfavorable for artificial recharge.

Table 4.1 illustrates the existing water resources, the estimated 1990 demands, and the proposed sources of future supply for the Cape Cod and Islands planning area. With the large increase in summer population, water supply facilities must be designed to provide sufficient amounts of water to meet maximum summer demands. Base information used in projecting future demands is daily average of the total amount of water required over the entire year. Therefore, based on a review of previous reports (*Alonzo B. Reed, Inc., 1970 Comprehensive Report on Water Supply and Sewerage*), the projected average-day demands have been increased by 50 percent before the design flow is calculated to account for seasonal fluctuations in demand.

TABLE 4.1 SUMMARY OF 1990 WATER SUPPLY: CAPE COD AND ISLANDS

Municipality	Existing System (1970)		Adjusted 1990 ^{b/} Average Demand (mgd)	1990	Proposed Additional Sources of Supply
	Source	Safe Yield ^{a/} (mgd)		Design Demand ^{c/} (mgd)	
CAPE COD					
Barnstable	Wells	14.5	9.42	15.83	Ground water
Bourne	Wells	5.9	3.93	3.93	Ground water
Brewster	Private Supplies	0	0.36	0.86	Ground water
Chatham	Wells	3.9	1.43	2.99	Ground water
Dennis	Wells	6.1	3.94	7.37	Ground water
Eastham	Private Supplies	0	0.46	1.08	Ground water
Falmouth	Long Pond, Wells	14.1	5.36	Same	Ground water
Harwich	Wells	7.2	2.60	5.10	Ground water
Mashpee	Wells	1.2	0.29	0.71	Ground water
Orleans	Wells	2.1	1.07	2.30	Ground water
Provincetown	Wells ^{d/}	2.1	1.36	2.86	Ground water
Sandwich	Wells	1.6	1.22	2.58	Ground water
Truro	---- See Provincetown ----		0.60	1.37	Provincetown
Wellfleet	Private Supplies	0	0.23	0.57	Ground water
Yarmouth	Wells	6.9	6.21	10.99	Ground water
ISLANDS					
Chilmark	Wells	0.05	0.04	0.12	Ground water
Edgartown	Wells	5.2	0.58	1.31	Ground water
Gay Head	Private Supplies	---	---	---	Private wells
Gosnold	Wells	0.14	0.02	0.05	Ground water
Nantucket	Wells	3.7	0.94	2.06	Ground water
Oak Bluffs	Wells	1.3	0.54	1.24	Ground water
Tisbury	Wells	5.0	0.68	1.53	Ground water
West Tisbury	Private Supplies	0	0.05	0.12	Ground water

^{a/} Ground water yield is reported as pumping capacity of system.

^{b/} Projected 1990 average day demand increased by factor of 50 percent, as described in the previous discussion.

^{c/} For systems relying on ground water, maximum day demands must be provided.

^{d/} Wells in Provincetown (0.3 mgd) and North Truro (1.8 mgd).

CHAPTER 5 WATER QUALITY

The Situation

Of all the planning areas in the SENE region, Cape Cod and the Islands have been recommended as the *highest priority area* for water quality planning funds by the agencies participating in the SENE Study.

Several important factors in establishing priorities are evident in this planning area and result in its high ranking. First, the planning area presently contains excellent quality fresh and coastal waters. It has, by a very wide margin, the highest quality water of any planning area in SENE. Thus, limited treatment facility construction projects will serve to maintain that excellence, rather than having to restore already polluted waters later. Construction funds allocated here should be relatively low since proper land use planning can minimize the extent of sewer service and attendant treatment facilities. The resultant small service areas will further tend to protect water quality by limiting urbanization and associated runoff. Some sewer service and treatment facilities will be needed, and returns from the investment — protection of ground water supply and contributions to recreation and tourism — should far exceed costs. Since the Cape is a nationally important recreation area, significantly more people than its permanent population are affected by water quality here. Given high priority, funds can be reserved for planning and necessary construction to ensure swimmable-fishable waters throughout the Cape and Islands well before 1983.

Rivers and streams on Cape Cod and the Islands are too small to serve as receiving waters for treated effluents. The present and proposed water-quality classifications for fresh waters in the planning area are Class B, suitable for contact recreation. The only exception is Long Pond in Falmouth, where an A classification was adopted, designating it solely as a water supply source for the Falmouth Water Department.

Proposed classifications for tidal waters are Class SA with only two exceptions: Cape Cod Canal, SB; Falmouth Inner Harbor, SB. The areas which do not currently meet these criteria are localized in nature and are probably the result of failing septic systems, direct discharges to surface waters by individual homes, and/or vessel pollution. The principal difference between Class SA and Class SB is that in the latter shellfish harvesting for direct human consumption is allowed only after depuration.

There are two basic problems facing this planning area: (1) burgeoning summer populations with resulting unreliable population projections on which to base facilities design; and (2) protection of both surface water and ground water quality while maintaining a water resource balance for long-term supply needs. Other general areas of concern are vessel and oil pollution. Neither of these latter two concerns are considered major at this time, but could have potentially serious effects on the beaches of the planning area and thus on the tourist industry.

Sewer Service Considerations

It should be made clear that the provision or withholding of sewer service is, and can be, a powerful means of determining growth patterns. Conversely, some land use control measures can be used to minimize the need for sewers or, in existing systems, the need for sewer extensions. This would result in most growth occurring in those areas capable of supporting subsurface disposal systems. Thus, the volume of effluent would be smaller, and less stress would be placed upon a land or water resource to assimilate the effluent. If extensive sewerage were chosen, as a result of allowing growth at densities or on land not suitable for septic sys-

TABLE 5.1 SEWER SERVICE: CAPE COD AND ISLANDS PLANNING AREA

Sewer System	1970 Population Served	Degree of Treatment	Receiving Water
Falmouth (Woods Hole)	5,500	Chlorinated	Great Harbor
Hyannis	5,000	Primary	Ground
Chatham	1,500	Secondary	Ground
Nantucket	3,774	Primary	Ground
Cuttyhunk	260	None	Vineyard Sound
Edgartown	1,600	Secondary under construction	Ground

tems, then large wastewater discharges could result. Increased land use densities with concomitant increases in urban runoff would also be an eventual by-product of sewerage.

The towns which currently have some form of municipal wastewater collection are listed below in Table 5.1.

On the Cape, and on Nantucket and Martha's Vineyard, where ground water quantity is a major consideration, sewer service and accompanying high land use density limit recharge of the ground water. It is obvious that since sewerage (or lack of sewerage) has so many diverse ramifications, a detailed investigation is needed. Projected land use based on extrapolation of past trends should *not* be the determining factor for sewer service areas. In fact, from a water quality standpoint, existing sewer service should be a determining factor in land use projections for a given area.

The Solutions

Subsurface Disposal and Eutrophication

An important factor in this planning area is the threat of pollution to water supplies by malfunctioning septic systems. The principal solution for minimizing septic system failures is the enforcement of rigid criteria and performance standards, coupled with use of new dry composting disposal units.

Water pollution by malfunctioning septic systems has often caused the need for additional sewer service and attendant treatment facilities. Rigid enforcement of existing regulations may preclude many of the problems of these systems. However, an in-depth look at the criteria for locating, siting, and designing individual subsurface disposal systems is also necessary since some aspects of existing regulations may still allow problems to develop. For example, high percolation rates coupled with the minimum allowable depth to ground water may result in bacterial contamination, nitrate build-up, or even phosphate build-up in that ground water. Also, allowing systems to be placed in fill material might invite clogging conditions at the fill-old surface interface.

Massachusetts has contemplated reviewing and updating its regulations regarding individual disposal systems and there is strong public pressure to revise these regulations. With proper enforcement, and by restricting the use of such systems to those lands suitable for septic tanks, individual disposal systems should continue to be useful for an important portion of future residential development. Without such precautions, the cumulative failure of individual systems will intensify pressure for sewer extensions and new treatment works. The result will be new concentrations of effluent in high quality streams and the ocean, loss of in-basin ground water resources, in-

creased municipal service costs, and, inevitably, the increased density of development induced by sewer service.

Increasing use of dry composting disposal units in individual residences will have important benefits, not only for water quality control, but for water supply planning. These waterless systems could alleviate the problems of present septic systems. Actively used in Scandinavian countries over the last 10 years, the only residue is a small quantity of compost which can be removed about once a year. Wastewater from kitchen and bathroom sinks, showers, and tubs must still be disposed in septic tanks or sewer systems, however.

The objective of the dry disposal alternative would be to provide individual disposal systems which will not only prevent human health hazards on-site, but would also prevent water quality degradation. Benefits will also be derived by the receiving watercourse if the need for sewers, and therefore effluent outfalls, can be delayed or eliminated through judicious use of dry composting disposal units. Based upon the foregoing discussion:

1. **Enforce local subsurface disposal regulations.** Together with the Department of Environmental Quality Engineering, municipalities should improve enforcement of local regulations governing individual subsurface disposal systems. The Department should give consideration to selectively allowing innovative dry or "composting" disposal units.

This recommendation should, after implementation, result in the need for fewer public sewer systems as well as achieving more efficient operation of subsurface systems.

In this planning area, hydrologic conditions are highly conducive to the premature eutrophication of ponds which are bordered by houses using septic systems for waste disposal. Soils having high permeability, like those on the Cape, do not provide the necessary removal of nutrients such as nitrates. The result is a substantial increase of algal fertilization and resultant eutrophication of water bodies. This process causes degradation of ponds which are otherwise highly desirable for recreation and development of permanent and seasonal homes. The following additional action is recommended (a) to prevent enrichment in currently unaffected fresh water ponds and in salt water ponds where ocean flushing is minimal, and (b) to reduce the flow of nutrients to already affected ponds:

2. **Establish local regulations to inhibit pond eutrophication.** Municipalities should establish zoning regulations (in conjunction with subsurface disposal regulations) that prevent use of waste disposal systems which would detrimentally alter a pond's nutrient balance.

Water Quality and Water Supply Coordination

There are two basic areas where design and construction activities for water quality control should be coordinated with planning for water supply facilities. The first is disposal of treated effluent through land application, and the second is location of the discharges from advanced wastewater treatment facilities.

Land application can be used to recharge ground water aquifers in certain limited instances where soils, climate, surficial geology, and other physical characteristics are favorable to such operations. Section 201 of the Federal Water Pollution Control Act Amendments of 1972 requires that, before a grant is given to construct a public treatment facility, "alternative waste management techniques have been studied," among which is "the reclaiming and recycling of water." While this report generally recommends ocean disposal for coastal communities, the Study also encourages municipalities, especially groups of municipalities which are dependent upon a single regional ground water source, to explore the feasibility of using treated effluent to augment recharge of their aquifers where local conditions permit.

The need to maintain the regionally-significant ground water aquifer underlying the Cape Cod communities, and the aquifers on Nantucket and Martha's Vineyard, has been discussed in the *Water Supply chapter of this report*. Here is a case where integrated water quality and water supply planning at an early phase is absolutely imperative. As stated in the Water Supply Chapter, the ramifications of improper planning for such a resource could negate the use of these important aquifers as a long-term water supply.

Disposal Methods

Where local conditions or existing systems have forced some degree of sewerage, three disposal options exist for wastewater: stream disposal; ocean disposal; and land disposal. There are also options for the configuration of treatment facilities: individual or regional facilities with minimal or extensive sewerage. Each has advantages and disadvantages which must be carefully evaluated before implementation. Table 5.2 presents preliminary evaluations of each. Because of the finite ground water supply in this planning area, it is a conclusion of the SENE Study that, *over the long-term, the only viable disposal medium would be to the land.*

The concept of *land disposal* can be an excellent one where there is concern about lowering water tables (ground water, pond levels, streamflows) and salt water intrusion. Unfortunately, the application of land disposal technology is highly dependent upon existing environmental conditions at a given location. Major factors involved in site selection include: type, drainability and depth of soil; depth, quality, and use of ground water; topography; climate; and consideration of public access to the land. It is obvious, then,

that land disposal cannot be undertaken without very detailed site investigations. Currently, a demonstration project is being conducted at Otis Air Force Base to determine the feasibility of using spray irrigation techniques for Falmouth's wastewater. This study will do much to determine the reliability of spraying secondary effluents on land on the Cape.

In any event, ground disposal of secondary treated wastewater effluents can be done in a way which lessens the potential for contamination of ground water supplies. In some instances, the threat can be reduced by the location of disposal facilities "downstream" of water supply wells, if such facilities are properly designed and operated. While not providing a direct recharge of the supply, this method can reduce salt water intrusion under certain geologic conditions, thereby indirectly enhancing well supplies. Individual municipal investigations will have to be conducted to determine that location which would maximize water supply benefits while minimizing ground water degradation. In the event that the effluents must be discharged to well supply recharge areas, advanced treatment could be instituted to protect those supplies. Costs would be high. However, an advanced wastewater treatment facility could be used in the future as the first stage of a water reclamation plant for municipal reuse.

Regionalization

The question of regional as opposed to individual wastewater treatment facilities also needs to be addressed on the Cape. Large communities with limited budgets and scattered population districts would find it hard to operate several small plants. For this reason, regionalization with an adjacent community should be attractive. This is the case with the South Sagamore section of Bourne and the town of Sandwich. Sections of Yarmouth, Dennis, and Harwich may find it economical to be served by a single regional facility. Provincetown and Truro may do likewise. On Martha's Vineyard, a regional treatment facility possibility exists for Oak Bluffs and Tisbury.

While certain economies of scale exist, potential regional treatment facilities also have disadvantages. Larger discharges would result, thus concentrating wastewater effluents and making ground disposal difficult. In contrast, individual facilities would have quite low flows, thereby reducing the potential for ground water pollution. Were the maintenance of ground water supplies less critical, land disposal could be dropped in favor of ocean disposal, and regionalization would be the best situation. However, the need for ground water supplies makes smaller systems a more acceptable alternative.

In light of these considerations, the following recommendations are made:

3. Construct or expand small collection systems in 14 towns. The following towns

TABLE 5.2 EVALUATION OF OPTIONS FOR WASTEWATER TREATMENT: CAPE COD AND THE ISLANDS

Option	Social	Technical	Environmental	Economic	Legal, Institutional and Political
A. Extensive sewer- ing based on existing zoning and existing problem areas.	Would allow denser develop- ment to spread according to zoning patterns. Might induce higher popula- tions.	Can be accomplished. Would eliminate scattered problems effectively. Would result in fairly large wastewater flows which could pre- clude subsurface disposal.	Would open more land to develop- ment. Somewhat more runoff. Less ground water re- charge if ocean disposal used.	Costs to indi- viduals would be somewhat offset by the high density allowing great- er economic growth.	Some opposition to this type of develop- ment or one of higher density.
B. Minimal sewer- ing of existing problem areas and potential problem areas already devel- oped.	Would result in lower densities outside of pre- sent town cen- ters. Could tend to slow popula- tion growth.	Would eliminate problem areas. Smaller wastewater flows.	More open space but low density housing over wider area than A. Em- phasizes dispersion, not clustering.	Less expensive than above.	Same opposition due to expected limits on growth.
C. Ground disposal	Area used for filter beds would not be aestheti- cally pleasing.	Can be accomplished, but must treat to ensure ground water quality.	Would return ground water and eliminate any possibility of ocean contamina- tion, would pre- empt large areas for filter beds.	Land costs would be more than D. Degree of treatment might be higher than D. Inland interceptor would not be needed in D.	Opposition due to fear of ground water degradation. The Mass DPH is currently opposed to large ground disposal sys- tems.
D. Ocean disposal	Coastal property probably taken for facility.	Adequate ocean outfall required.	Would deplete ground water, possibly to a great extent if done by all communities. Potential ocean contamination.	Only added sig- nificant cost would be that of outfall.	Opposition due to sensitive nature of beaches and delicate balances between water use and supply sources.
E. Individual municipal wastewater treatment facilities.	People could control own plant, although some small plants are not as well run as larger ones.	Municipalities would be able to proceed at own speed.	In several instances, could result in side- by-side discharges to ocean. Land disposal somewhat easier since smaller flows more widely spaced.	Economies of scale are missing	Only internal problems for each municipality.
F. Regionalization	Municipality with plant might not wish to treat other towns' wastes. Municipality without plant would lack control over operation of facility.	Might take longer to accomplish, due to problems of coordination. Larger plants usually run by better trained personnel, and have better and bigger equipment capa- bilities.	Fewer discharges but larger. Would probably mean higher degrees of treatment needed. Land disposal would be less feasible, due to high volume of wastewater flows.	Should be cheap- er than E, al- though potential external costs from lowered water tables could be great.	Inter-municipal arrangements needed.

should consider constructing small collection systems or, where they exist, expand existing systems on Cape Cod: Bourne, Sandwich, Falmouth, Barnstable, Yarmouth, Dennis, Harwich, Provincetown, Orleans, Wellfleet, and Truro; and on Martha's Vineyard: Oak Bluffs, Tisbury, and Chilmark may require systems.

4. Construct three new collection systems on Nantucket. Nantucket should construct three additional dispersed collection systems and determine the number of treatment facilities needed.
5. Investigate five possible intertown sewer service areas. The following towns should investigate feasibility of regionalization: South Sagamore section of Bourne with Sandwich, Buzzards Bay section of Bourne with Wareham, Dennis with Yarmouth and Harwich; and on Martha's Vineyard: Oak Bluffs with Tisbury. Provincetown could accept flows from Truro, if sewer service is necessary.
6. Construct small secondary plant at Cuttyhunk with pump-out facilities for visiting yachts. The Cuttyhunk section of Gosnold should construct a secondary treatment plant with land disposal and, if feasible, a coastal pump-out facility for yachts.
7. Consider land disposal, when proven feasible. Where feasible, planning area towns should make every attempt to provide for land disposal of wastewater. Municipalities with existing coastal discharges should at least provide secondary treatment unless outfalls are to be abandoned in favor of land disposal.

These proposals have been drawn from regional planning agency reports and should be included for consideration in any basin plan developed by the Massachusetts Division of Water Pollution.

Preliminary costs include only major interceptors and treatment facilities: Bourne — \$2,700,000 not including Buzzards Bay section to Wareham for which costs are not available; Sandwich — \$2,400,000; Falmouth — \$14,000,000 (assumes land disposal); Barnstable — \$2,250,000; Yarmouth — \$1,500,000; Dennis — \$1,600,000; Harwich — \$1,000,000; Provincetown — \$3,700,000; Edgartown — \$5,500,000; Oak Bluffs — \$10,000,000; Tisbury — \$5,500,000; Chilmark — \$500,000; Nantucket — \$14,600,000 if three additional treatment facilities are needed. Wherever regionalization was considered possible, the costs reflect regional shares of construction.

Anti-Degradation

The Cape and Islands planning area is in a unique situation in that the coastal waters and fresh water streams are generally of excellent quality. Thus, unlike other basins, any *money spent for treatment facility construction will be money spent for preservation rather than after-the-fact restoration*. As a consequence of this fact, the anti-degradation clause of the Massachusetts Water Quality Standards is directly applicable. This states that the Department of Environmental Quality Engineering should ensure that no new discharges will deteriorate the quality of salt water which has been designated Class SA or SB (shellfish flats and swimmable-fishable salt water), nor any river or stream above the most upstream municipal discharges. The only exceptions should be allowed under the following conditions:

- (a) to allow new cooling water discharges if standards of the receiving waters are met;
- (b) to allow new municipal discharges if part of an overall comprehensive plan; and
- (c) to require existing discharges to cease and either connect to a municipal system or, if a municipal system is unavailable, to install the highest degree of treatment available so as not to degrade the high quality receiving water.

Notwithstanding provision (b) above, an environmental impact statement is required for all major new discharges.

Vessel Wastes

Yet another potentially serious pollution problem facing the Cape is the disposal of vessel wastes. The waters surrounding the Cape host over 20 percent of the total recreational fleet in Southeastern New England, a fleet which discharges 5.3 million gallons of raw or only slightly treated waste water each season. Transient summer fleets greatly multiply this number.

Although these loads can be dwarfed by municipal, industrial, and combined sewer discharges in some areas, the adverse health and aesthetic conditions which can be produced, especially in poorly flushed marina areas and harbors, are of serious concern. Their effects may become more obvious as point sources of pollution are abated.

While federal regulations will allow properly treated discharges, Massachusetts is taking a more restrictive position, favoring individual vessel holding tanks and the construction of pump-out facilities at selected marinas or near municipal treatment facilities. This policy is endorsed, and it is further

recommended that municipalities:

- 8. Construct pump-out facilities at marinas wherever possible.** The Massachusetts Department of Environmental Quality Engineering should:
 - (a) have publicly owned treatment plants along the coast provide pump-out facilities; and/or
 - (b) require all marinas in heavily congested harbors and adjacent to major harvestable shellfish beds and swimming areas to provide pump-out facilities with either adequate treatment or disposal to a municipal system.

Landfills

Several landfills in the planning area have been identified as having problems which could cause, or have caused, water quality degradation now or in the future. Problems with surface drainage, leachate, and lowest portion of the fill in the water table are experienced by sites in: Barnstable, Dennis, Provincetown, and Wellfleet. Yarmouth experiences only the water table problem. A related problem is the proper disposal of used motor oil which contains hydrocarbons. There are concerns that these hydrocarbons may contain carcinogenic compounds which could adversely affect well supplies under certain conditions. Related problems of fills and

structures in coastal wetlands and waters are controlled by the permit system of the U.S. Army Corps of Engineers.

So little is known, however, about the implications of these problems, that the following is recommended:

- 9. Study pollution of ground and surface waters by solid waste leachates.** Further field investigation by the Department of Environmental Quality Engineering is needed to better define the water quality problems associated with existing and abandoned solid waste disposal areas located near the surface and ground waters of the planning area.

In communities experiencing high development pressures, the following is also recommended:

- 10. Attenuate runoff from new urban development.** To control runoff and sediment in new developments, municipalities should adopt zoning and subdivision controls which emphasize open areas and the use of permeable drainage ditches and provide attractive, safe stormwater detention ponds, thereby also augmenting ground water recharge.

CHAPTER 6 OUTDOOR RECREATION

Cape Cod is slightly more than an hour away from metropolitan Boston and within one day's drive of one third of the nation's population. This accessibility, coupled with the aesthetic, natural, and recreational attractiveness of the Cape and the Islands has resulted in the development of a thriving and expanding tourist industry for the area. Income from recreation-related transactions on the Cape in 1971 totaled \$76 million. Its extensive beaches and characteristic colonial New England villages cause the Cape's summertime population to swell to more than three times its permanent 107,000 residents. SENE's largest beach facility, the National Seashore which is managed by the National Park Service is located on Cape Cod. Present policies for managing the Seashore aim to preserve the particular environmental amenities, but in view of the regional demands projected, these policies may require review and revision in the future.

Seasonal growth has placed tremendous pressure not only on the ability of the Cape's transportation, water supply, and sewer system utilities to adequately service the influx, but also upon the very recreational resources which attract the visitors in the first place. National Seashore parking lots are filled to overflowing, waiting lists for campsites at the Nickerson State Park, Hawkes Nest Pond, and Ashawme Cove are long, and the traffic jam trying to get on the Cape is exceeded only by the one trying to get off.

Nevertheless, the variety and quality of the Cape's recreational opportunities is unequalled in the SENE Study area.

The opportunity to achieve the goal of resource conservation while accommodating tourism still exists if action is taken in the near future. The Cape and Islands residents are the caretakers for a wealth of magnificent resources: innumerable beaches; inland water bodies; miles of coastal waters; productive and attractive salt marshes; dunes, bluffs, moraines and plains; wildlife; and some of the best deep sea fishing anywhere. The Cape's natural and historic legacy contributes directly to SENE's high quality environment and indirectly, through tourism, to its economy.

SWIMMING

The Situation

The most important recreational resources on the Cape are the beaches. Including the six operating National Seashore Beaches, Cape Cod, Martha's Vineyard, and Nantucket combined have 146 publicly owned beaches, amounting to well over 500 acres. Estimates by the Corps of Engineers and

Bureau of Outdoor Recreation (BOR) indicate that this amount is nearly adequate to satisfy the 1990 tourist and local demands for swimming. The major problem is transportation to the beaches, particularly on the Islands. Other beach uses are discussed in the Salt Water Fishing section. Beach area sufficient for future needs is a circumstance nearly unequalled in the rest of the SENE region.

The main problem with satisfying swimming needs will be the adequacy of transportation and parking. Although bathers are rarely turned away at this time because of a lack of parking, new lots will eventually have to be built. One is reluctant to even consider them, however, because they are incompatible with fragile beach resources and because of their relationship to the Cape's terrible traffic congestion. Public transportation for day trippers from the metropolitan area is also inadequate, although public transportation systems could alleviate much congestion.

The Solutions

Though there are at least three different options for meeting future swimming needs (*see Chapter 6, SENE's Regional Report*), only two of them apply to the Cape and Islands:

1. **Consider building parking lots on Route 6 with buses to the beaches. In addition to the actions listed previously under Chapter 3, *Guiding Growth*, the Cape Cod Joint Regional Transportation Committee should consider constructing new parking facilities at appropriate intersections along Route 6, with shuttle bus service to the beaches. No major parking lots should be built at the beaches themselves, nor should highway access routes be built. In addition, the feasibility of summer trains from Boston to Barnstable and beach shuttle bus connectors should be studied.**

Much of the Cape's and Islands' privately owned beach front is casually used by the public. This circumstance, while adequate for local needs, is inefficient for satisfying the beach needs of the entire planning area in the long-run.

Massachusetts residents do not have a "free" right of access along the foreshore. This was confirmed in July, 1974, when the Massachusetts Supreme Judicial Court ruled unconstitutional proposed legislation to codify a general public right to the foreshore (H. B. No. 6438). The public has limited rights, dating to Colonial times, with respect to "angling" and "fowling" and navigation uses, but these need clarification in modern terms.

A Special Legislative Commission on Availability and Accessibility of Public Beaches is continuing to consider alternative ways of opening more Massachusetts beaches to the public. A current report suggests three kinds of action: equalizing parking fees at town beaches for residents and non-residents; requiring non-profit organizations holding tax-exempt status to permit public access to beach property; and automatically opening beaches and property that remain unposted and open to the public for over five years under a right of way dedication statute. There are serious problems with each of these actions; for example, "the dedication to public use" provision might well stimulate private property owners to close beach access presently unofficially open to the public to prevent loss of the private status.

The SENE Study encourages the Commonwealth to:

2. **Secure public access to the shoreline.**
The Commonwealth should continue, as a matter of policy, efforts to secure public access to the coastal shoreline, with careful regard for the protection of fragile ecosystems and for minimizing negative impacts on affected communities and individuals. In view of severely limited public access rights to the foreshore, the Commonwealth should pursue an implementable clarification of the angling-fowling-navigation right granted in Colonial times. The Commonwealth should also consider possibilities of various means of state sharing of costs of access, traffic control, facility development, and maintenance and operation in return for general public access to Town beaches. User fees should be carefully addressed as a means of direct beneficiaries bearing a portion of the cost, including use on the basis of such fees. The Commonwealth should also continue to explore other alternatives for legislation and programs to improve public access to the foreshore generally.

These solutions would contribute significantly to relieving traffic congestion on the Cape's secondary roads and would ensure the protection of fragile beach areas from parking lot construction. Options of acquiring and developing new public beaches and developing additional facilities at beaches not under protection and capable of sustaining intensive use must also be considered.

SALT WATER FISHING AND RECREATIONAL BOATING

The Situation

The Cape Cod planning area is a nationally prominent recreational boating center and vacation area. Approximately 11,600 recreational craft (excluding trailered boats) are based at over 30 significant recreational harbors which dot the Cape and Islands. A major generator of the boating activity is recreational salt water fishing, one of the major attractions of both Cape Cod and the Islands. The south shore of the Cape is rich in a variety of species, while the bay area fisheries are dominated by flounder, stripers, and bluefish. Approximately 100 party and charter boats operate from the Cape Cod harbors. Provincetown, Wellfleet, Orleans, and Dennis are the principal sportfishing harbors on the north shore, or Cape Cod Bay side. Chatham, Harwich, and Hyannis are the principal sportfishing ports along the south shore, or Nantucket Sound side. Nantucket and Martha's Vineyard host three nationally-known tournaments; the Nantucket Bluefish Tournament in August, the Cuttyhunk Swordfish Tournament in July or August, and the Martha's Vineyard Striper and Bluefish Tournament in September and October.

Assuming the current New England average of 8 percent of the population fishing in salt water an average 12 days/year at an estimated value of \$10.77/day, during 1970, saltwater fishermen of the planning area expended approximately 80,000 fisherman days and \$862,000 in pursuit of their sport. Saltwater fishing demands are expected to increase to approximately 120,000 fisherman days by 1990. Such recreational demands are conservative in view of estimated fisherman days for 1970-71 period. Piehler, in a doctoral dissertation for the University of Massachusetts (1971), found that during this period alone there were 354,000 fishermen days in a southeastern Massachusetts area including Cape Cod.

Servicing this demand are 62 boat launching ramps, 23 jetties or fishing piers, and 12 surf fishing access points. Many town and public beaches are also available to surf-casting fishermen, even during the tourist season. Practically the entire Cape Cod Canal is available to shore fishermen, as is the National Seashore.

Nearly half the Cape's coastline is inaccessible to the public. Surfcasters, shellfishermen, and beachcombers would bene-

fit if they had better access to the shoreline. Recommendation number 2 in this chapter discusses means for obtaining this access.

Boating facilities along the Cape's shoreline are important for deep sea fishing and for sailors. Based on a 1972 air-photo count, conducted by the Corps of Engineers, the approximate recreational boating fleet by town is presented in Table 6.1.

Boating conditions on Cape Cod are often crowded, and facilities are not always adequate during the tourist season. The biggest boating problem on the Cape, Vineyard, and Nantucket is that many of the entrances to the bays have a tendency to shoal, requiring costly dredging and construction of jetties. This problem is expected to continue and constant maintenance is apparently the only way to solve it.

The 1990 demands for increased boating facilities have been modified to account for higher inflation rates, fuel costs, maintenance rates, and increased insurance and tax costs.

Based on such considerations and given expected population growth, over a thousand boats will have to be accommodated by 1990. Following a physiographic, land use, and accessibility analysis, the estimates shown on Table 6.2 were derived by the Corps of Engineers for each community's boating development potential.

The Solutions

One action essential for solving the Cape and Island's most important problem related to harbor maintenance is the following:

3. **Maintain, or dredge, up to ten recreation boating channels.** The Massachusetts Department of Public Works, in conjunction with the municipalities and the Corps of Engineers, should consider the dredging of West Falmouth Harbor and Eel Pond. Areas which may require operational maintenance include: Red Brook Harbor in Bourne; Falmouth Inner Harbor; Cotuit and Hyannis Harbors in Barnstable; Bass River in Yarmouth and Dennis; Stage Harbor in Chatham, Sesuit River in Dennis; Wellfleet Harbor, Cuttyhunk Harbor, Menemsha Creek, Oak Bluffs Harbor, Lagoon Pond, Edgartown Harbor, and Nantucket Harbor.

Chapter 7 of the Regional Report recommends the continuation of interim regulations for dredged materials disposal, until new techniques and guidelines are advanced. Meanwhile the Study endorses investigations into the use of dredged materials for beach restoration and saltmarsh development, and recommends that shellfish flats and wetland wildlife habitats be avoided in all aspects of dredging activities.

**TABLE 6.1 EXISTING RECREATIONAL FLEET BY MUNICIPALITY:
CAPE COD PLANNING AREA**

Municipality	Slips	Moorings	Total
CAPE COD			
Bourne	315	835	1,150
Falmouth	875	1,310	2,185
Mashpee	240	135	375
Barnstable	840	1,080	1,920
Yarmouth	240	315	555
Dennis	425	375	800
Harwich	330	255	585
Chatham	155	940	1,095
Orleans	260	120	380
Eastham	40	60	100
Provincetown	65	85	150
Truro	---	55	55
Wellfleet	150	115	265
Sandwich	75	5	80
Cape Cod Totals	4,010	5,685	9,695
ISLANDS			
Nantucket	200	425	625
Martha's Vineyard	410	665	1,075
Elizabeth Islands	90	90	180
Islands Totals	700	1,180	1,880
Cape and Islands Totals	4,710	6,865	11,575

Two main approaches for satisfying future boating demands are maximizing the use of existing facilities, and developing as many new ones as possible. The first concentrates the development of onshore ancillary services in a few spots, unlike the second, which stimulates growth and can be quite expensive if dry storage facilities are involved. Recommendations for meeting the Cape's boating demands are based on more detailed evaluations of these two approaches in *Chapter 6 of the SENE Study Regional Report*.

Further, *highest priority* in this planning area is suggested for maximizing the use of existing marina facilities. Admittedly, from past experience, dependence on any private recreational entrepreneur is risky, due to the unavailability of funds to get the business going, and high risks of failure once it is underway. Also, to the detriment of Critical Environmental Areas and therefore to local environmental quality, not much forethought has been given in the past to development in the most suitable locations. To improve on these past shortcomings, the Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles, together with the Department of Environmental Management and private recreational interests, should form a committee to guarantee loans for recreational entrepreneurs. These agencies should also plan for, and suggest, suitable locations for developments, and prepare developmental standards which towns could enforce through building and sanitary standards.

As an offshoot of this committee, guidance could be made available to marina operators for satisfying future boating needs. Toward this goal, at least one community, Dennis, has formed a boating advisory committee. Such an organization is essential on the state level for assuring orderly boating development all along the Commonwealth's coastline. Therefore, the following actions are recommended:

4. Guide future marina development. A state boating advisory committee should advise and work with state and local governments to help plan and foster orderly boating growth, by encouraging more efficient use of existing marinas through dry storage and other modern techniques. This committee should classify each of the Cape's harbors according to the capacities to accommodate additional boating with fewest impacts on the environment and infrastructure. Details about membership and organization are in the *Regional Report*. In addition, the Association for the Preservation of Cape Cod has suggested that environmental impact statements be required for new marina developments.

5. Encourage fore-and-aft mooring practices

TABLE 6.2 RECONNAISSANCE OF POTENTIAL FOR RECREATIONAL BOATING FACILITIES *

Municipality	Potential Additional Slips	Potential Additional Moorings	Potential Additional Spaces
Barnstable	40	190	230
Bourne	—	80	80
Brewster	—	—	—
Chatham	200	520	720
Chilmark	20	60	80
Dennis	100	250	350
Eastham	50	100	150
Edgartown	—	400	400
Falmouth	120	30	150
Gay Head	—	—	—
Gosnold	—	—	—
Harwich	75	100	175
Mashpee	20	—	20
Nantucket	—	130	130
Oak Bluffs	25	200	225
Orleans	200	820	1,020
Provincetown	—	70	70
Sandwich	—	—	—
Tisbury	—	50	50
Truro	—	—	—
Wellfleet	120	—	120
West Tisbury	—	—	—
Yarmouth	—	50	50
TOTALS	970	3,050	4,020

* These are preliminary estimates and **should not** be construed as justification for marina development or expansion. Further study — either by towns or by the proposed statewide boating advisory committee (see recommendation 5 in *Chapter 6 of the Regional Report*) — is needed to determine capacities for new facilities.

in protected anchorages. Where feasible, the boating advisory committee, *proposed in Regional Report Chapter 6*, should encourage harbor masters to consider fore-and-aft mooring anchorages in order to reduce the mooring space required per boat. This should be considered in Bourne at Red Brook Harbor; in Falmouth Inner Harbor and Waquoit Bay Harbor; in Barnstable at Cotuit and Hyannis Inner Harbors; on the Bass River in Yarmouth and Dennis; at Stage Harbor in Chatham; and on Martha's Vineyard, at Edgartown Harbor; at Oak Bluffs Harbor; and Menemsha Harbor in Chilmark.

Provincetown Harbor is fairly exposed and therefore has rough water conditions for recreational and commercial boats. The breakwater recently constructed by the Corps of Engineers has helped, but local interests have noticed additional problems with winds. The next step toward solving the problems is for municipal officials to continue to request either the Corps of Engineers or the Commonwealth to determine the economic feasibility of extending the breakwater eastward.

As mentioned previously, the shoreline is an important resource for surfcasters, shellfishers, and beachcombers. *Chapter 6 of the Regional Report* discusses the importance of gaining public rights to the foreshore for satisfying those low intensity pursuits. Therefore, recommendations to provide public access to the foreshore and acquire access points gain importance for saltwater fishermen:

- 6. Construct fishing piers and boat ramps along the shoreline.** The Public Access Board should acquire access points to the shoreline at regular intervals and, with the Department of Public Works, construct fishing piers and boat ramps. For economies of scale and the protection of Critical Environmental Areas, these access points should be planned in conjunction with the parking lots and shuttle service along Route 6 mentioned in the *Swimming* section. Where parking lots for boat ramps must be provided, they must not conflict with Critical Environmental Areas.

The Study encourages the development of boat ramps because they accommodate more boats, with fewer environmental impacts, than the alternative of marina development.

Failure to implement the other recommendations could lead to marina development which is unsatisfactory for boaters, and for the local infrastructure, and for the protection of Critical Environmental Areas.

Marina proposals should incorporate designs that minimize disruption of currents, restriction of the tidal prism, and excavation in shallow water, and prohibit removal of barrier beaches, filling of wetlands, and filling of shallows beyond the normal high water line and should preserve environmental values.

GENERAL OUTDOOR RECREATION

The Situation

An unusually large amount of the Cape's water and related land resources is dedicated to recreational opportunities for the public. Forty-seven thousand six hundred (47,600) acres of recreation and conservation land exists — about 12 percent of the total acreage. Of that total, the Cape Cod National Seashore accounts for nearly 27,000 acres, and the Monomoy Wildlife Refuge adds another 2,700 acres of federally owned open space. About 6,600 acres of the total recreation acreage are state-owned, including Nickerson State Park (2,100 acres), Martha's Vineyard State Forest (3,000 acres), and other areas like Ashawme Cove and Hawkes Nest Pond (2,000 acres). Local areas total 4,800 acres, including many town beaches, landings, and town forests. Private recreation flourishes in the area because of the tourist trade, and accounts for 7,200 acres, including various private reservations, private and commercial beaches, commercial campgrounds, and private camps.

There are also a great many opportunities to develop new sites or to expand existing inland recreation sites on Cape Cod, Martha's Vineyard, and Nantucket. The Martha's Vineyard State Forest, and potentially surplus military lands such as the U.S. Coast Guard property in Siasconset on Nantucket, or portions of Otis Air Force Base in Bourne, could be used for many different activities including recreational camping.

Among the many possible recreational uses of these resources, the Study has examined 1990 demands for camping, picnicking, and extensive outdoor recreation (hiking, informal picnicking, nature study). BOR estimates that the existing acreage is more than adequate to satisfy extensive needs, the existing campgrounds are adequate to satisfy about a fifth of the 1990 needs for campsites (about 650 additional required) and the existing picnic facilities are adequate to meet about one-sixth the 1990 needs for picnicking (roughly 1000 additional picnic facilities should be developed). Clearly there is a need to develop additional picnic facilities and campsites.

Campground developers are beset with many of the same problems as marina operators, including frequent municipal ordinances against their facilities. While there are ample opportunities to improve the camping and picnicking situation, the municipalities do not realize the same kind of income on these activities that they do on hotels or restaurants,

and, therefore, discourage their construction. As a matter of fact, police and fire protection and roads for campgrounds cost municipalities more than they do for hotels, although other costs for water, sewer, or traffic-control may not be as high.

The 9000 acres of fresh water ponds are a relatively untapped source of public recreation opportunity. The largest of these, Mashpee Pond (729 acres), Wequaquet Lake in Barnstable (654 acres), and Long Pond (743 acres) and Mill Pond (358 acres), both in Brewster, could all be further developed by the state for public access and picnicking. The state might also develop additional camping facilities by acquiring suitable sites at these and other ponds as the opportunities arise, in order to alleviate the camping demands on the existing facilities, such as those occurring at Hawkes Nest Pond in Harwich.

Strict local zoning and public acquisition of critical resources such as wetlands, high-yield aquifers, flood plains, beaches, and steep slopes should be undertaken consistent with the Study's policy for managing Critical Environmental Areas shown on Plate 2. Such local management will require the expansion of those concepts proposed in the recently adopted Massachusetts Act to Protect Land and Water on Martha's Vineyard. Direct technical assistance to groups of local governments by the Department of Community Affairs will be required to expedite this program. Solutions are discussed in greater detail in *Chapter 3 of this report*.

The Solutions

The two most important options for satisfying 1990 needs for campsites and picnic facilities are more intensive development of existing parks and recreation areas, and the encouragement of new campground developments. While the first option has cumulatively fewer environmental impacts, the second would probably satisfy more demands. Conversely, the second represents the same threats to local environmental quality and local economies mentioned above. The recommended actions represent a balance of the two approaches.

The state recreational advisory committee proposed in the recreational salt water fishing and boating section is one solution to problems so frequently connected with the development of campground facilities. In addition, to satisfy the future needs, new campgrounds will also have to be developed. Therefore, the SENE Study recommends the following:

7. **Encourage private campground and picnic area developments.** Local zoning ordinances should be changed if necessary, to allow carefully controlled and well-designed camping facilities where resources are appropriate and

access is suitable. The proposed state recreational advisory committee (*Chapter 6, SENE Regional Report*) should actively encourage these town-by-town changes by providing technical assistance in designing or reviewing plans for local or private camping facilities, particularly near the Cape's numerous ponds and lakes.

8. **Increase the number of picnic facilities at the National Seashore, as necessary.** The National Park Service should increase the number of picnic facilities in, and around, the National Seashore if overuse of existing facilities becomes apparent. Public sentiment strongly recommends that the National Park Service not develop facilities such as additional roads or campsites that would intensify public use of the Seashore. Furthermore, in keeping with existing policies, natural forces such as coastal beach erosion should be allowed to run their course along the Seashore coastline.
9. **Manage Critical Environmental Areas for camping, picnicking, or hiking.** The Massachusetts Department of Community Affairs, in cooperation with the Department of Environmental Management should provide technical and legal assistance to the municipalities through the local municipal boards and Cape Cod Planning and Economic Development Commission to zone or acquire, and subsequently manage, critical resources. These should include wetlands, high-yield aquifers, flood plains, and steepest slopes, called Critical Environmental Areas and shown on the Development Capabilities Map (Plate 2). Suitable acreage might be developed for campsites, picnicking, or hiking.

Several other actions are recommended to improve accessibility around the Cape and Islands, and to protect critical resources for conservation and extensive pursuits:

10. **Acquire upland natural areas.** The Massachusetts Department of Environmental Management in conjunction with the towns, should acquire additional natural areas including military properties such as U. S. Coast Guard lands on Nantucket (should they become surplus) and, if they become available, islands such as Tuckernuck, Muskeget, or Basset's Island in Bourne, for limited public outdoor recreational purposes.
11. **Maintain Noman's Land as a wildlife preserve.** Federal control of Noman's Land off Martha's Vineyard should be continued as a wildlife preserve, should it become surplus.

12. **Construct bicycle paths.** Massachusetts Department of Public Works and the Department of Environmental Management should construct additional new bicycle trails on Cape Cod and Nantucket with construction monies appropriated from the state highway trust fund.

Plate 2 shows the location of Critical Environmental Areas, which, as *Chapter 3* explains, have important roles in natural processes such as riverine and coastal flooding and erosion protection, water supply, and wildlife habitat. These areas are suitable for certain degrees of recreation, especially low-intensity activities. Since protection and development of such resources is best coordinated at the local level, the SENE Study recommends:

13. **Use SENE Development Capabilities Map for open space protection.** Municipalities should use Critical Environmental Areas identified on SENE Study Development Capabilities Maps for open space protection and greenbelt programs. Methods for protecting such resources without outright acquisition are described in *Chapter 3 of the Regional Report*.

The solutions discussed above primarily speak to increasing the amount of publicly available recreational opportunities. At a minimum, they would help to meet a substantial portion of the total picnic and camping requirements. They depend largely on state investment or action on a large scale. The alternative option would be to rely heavily on local action, such as the adjustment of local zoning codes to permit private campground developments. The problem is not just inadequate campsites, but also municipal services to support the developments, so that municipalities would most likely prefer to increase tax rates on campgrounds in order to pay for higher costs. This action would be incompatible with campground development, which actually needs tax reductions to survive off-season periods. A combination of state development and management of the areas would both satisfy demands for campsites and require fewer municipal services.

FRESH WATER FISH AND WILDLIFE

The Situation

Cape Cod has some of the most outstanding fish and wildlife resources in SENE. Over 80 percent of the Cape Cod and Islands planning area is either forest land, agricultural land, wetlands, or open water. Over 85 percent of the forest land is rated fair wildlife habitat and almost 44 percent of the planning area's wildlife habitat is open to hunting. Sixteen thousand (16,000) acres are publicly owned and open to public hunting; another 150,000 are privately owned and

open to hunting. Combined, these resources might be sufficient to meet planning area 1990 demands for hunting and non-consumptive wildlife enjoyment. However, to ensure that wildlife resources are available, they need to be protected either through legislative measures to protect habitat or outright acquisition.

More public access to fresh water resources is required to meet planning area demands for fishing. Presently there is enough public access to fresh water fisheries to meet almost 42 percent of the total 1990 demands. The Cape and Islands area is one of only two SENE planning areas able to fully meet its fishing and hunting demands. Sportsmen from other parts of SENE, faced with inadequate fishing and hunting opportunities close to home, will travel to the Cape for a higher quality experience.

The Solutions

Chapter 6 of the Regional Report describes four options for satisfying the planning area's future demands for wildlife and two options for future fishing demands and their implications. The following recommendations are based on an evaluation of those options.

The fastest growing portion of the planning area embraces a large green space which is quite productive for wildlife. As long as it is maintained, it provides landscape diversity in this growing portion of the planning area. Therefore, the following action is recommended:

14. **Continue wildlife management on Otis Air Force Base.** The Massachusetts Division of Fisheries and Wildlife should continue the wildlife and hunting management programs now being phased out on the 3,000 acre Otis Air Force Base management area.

Due to the multiple benefits of wetlands for production of water and wildlife, the SENE Study has recommended their protection to the maximum extent possible. This can be done without harming the area's economic growth (*see Chapter 3 of the SENE Study Regional Report*). The Massachusetts Wetlands Protection Act authorizes municipalities and the state to grant permits for proposed alteration of wetlands, but often their efforts are frustrated by insufficient knowledge or expertise. Recently the Soil Conservation Service has developed a program whereby communities can get technical information about wetlands (and other natural resources) through the nearby Conservation District Office. Because municipalities can protect significant amounts of wetlands through legislative channels, the Study encourages them to enforce the legislation with this recommendation:

15. **Use the Natural Resources Planning Pro-**

gram to reinforce wetlands legislation.

The Cape and Islands conservation commissions should develop technical information needed to enforce wetlands legislation and to protect other natural resources through the Natural Resources Planning Program, administered by the Soil Conservation Service.

Outright acquisition is the safest assurance that wildlife habitats will be protected, and the state has the means to purchase large areas of regional significance. However, smaller wetlands and adjacent or separate uplands are often the most productive ones, and towns frequently prefer to control them. Hence, the following recommendation:

16. **Acquire the most productive wildlife habitats.** Communities and/or private interests should acquire wetlands most important for wildlife production (*identified in SENE Study single-purpose inventories available at NERBC*) throughout the planning area.

Edges between forest, field and wetland are often the most productive wildlife habitats. Some of the SENE Study's major policies involve the protection of prime agricultural soils, wetlands, and unique natural areas (Category A and B lands). Actions to protect these resources — described in *Chapter 3 of the Regional Report* — have secondary benefits for the wildlife enthusiast or hunter because of the implications for wildlife productivity.

Productive fresh water fisheries persist in the planning area's ponds, lakes, and streams. The Massachusetts Division of Fisheries and Wildlife has an active program of streambank acquisition and the Public Access Board is legally charged to acquire public access to "great ponds" (natural ponds 20 acres and larger for fishing, and natural ponds 10 acres and larger for other recreational purposes). To ensure the availability of fresh water fisheries for future generations, the SENE Study recommends:

17. **Include ponds 10 acres and over in Great Ponds legislation.** The Massachusetts legislature should change the existing Great Ponds Act to designate ponds 10 acres and larger as "great ponds" for fishing.
18. **Acquire access to the most productive fish ponds.** The Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles should evaluate ponds for potential fisheries production and acquire public access. There are at least 28 ponds 40 acres and larger of "good" or "best" fishery potential. This lengthy list can be obtained from *SENE Study single-purpose*

inventory available at NERBC.

19. **Acquire access to the most productive fish streams.** The Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles should evaluate streams in the Cape Cod planning area and decide which should have public access based on fishing potential. SENE Study single-purpose inventory has identified at least 10 streams with high fishery potential: Pamet River, Truro; Herring River, Wellfleet; Stony Brook, Brewster; Scorton Creek, Sandwich; Marston Mills River, Barnstable; Coonemessett River, Falmouth; Child's River, Falmouth; Quashnet River, Falmouth; Mashpee River, Mashpee (recommended in the *Regional Report* for state acquisition because of regionwide value for fresh water fisheries production) and Santuit River, Barnstable.

To assure the high water quality of these important recreational streams, future development on the lands nearby must be regulated according to the guidelines sketched in *Chapter 3*. Buffer strips must be acquired for the protection of highly valued fishing streams particularly for Scorton Creek in Sandwich, Mashpee River and Quashnet River in Mashpee, and the Coonemessett River in Falmouth. The Massachusetts Division of Fisheries and Wildlife and the South-eastern Massachusetts chapter of Trout Unlimited are studying the possibility of developing sea-brown trout in these streams.

Implications

Depending on local enforcement of wetlands legislation, the recommendations would substantially increase the amount of protected wildlife habitat. Information was not available to ascertain the effectiveness of options such as arranging state management of privately-owned wildlife lands in exchange for public access, or the possibility of enlarging the boundaries of state hunting areas. Private organizations will also play increasingly important roles in protecting valuable wildlife habitat to meet needs for nature study and open space. Past experience indicates that most wildlife enjoyment occurs on privately or quasi-privately owned lands.

The option of acquiring public access to all 286,400 acres of wildlife habitat was not recommended: first, because of the expense involved, second because hunting is prohibited in several towns, and third, because preferences expressed at the Cape Cod public workshop did not support the idea of public access to privately owned land. The option of creating new wetlands was considered, but not recommended because the high costs involved in initial outlay would be better spent in acquiring wetlands which already exist and are known to be highly productive. In the long-run, however the Study supports investigations into the use of dredged

materials for building coastal salt marshes.

The combined recommendations for fresh water fishing would succeed in meeting over 13 percent of the total 1990 demands. The alternative of creating impoundments was not considered because of the high economic and environmental costs and low return on satisfying total 1990

demands. While public sentiment against expanding licensing programs is very strong, the fact that many fishermen are unlicensed must be kept in mind. The option of expanding the state licensing program to include fishermen as young as 12 years old was considered, but was not recommended because of strong public opposition.

CHAPTER 7 MARINE MANAGEMENT

The major marine related issue in the Cape Cod planning area concerns shellfish and aquaculture. Since discussion in this Planning Area Report will deal only with this topic, additional information on other marine problems can be found in *Chapter 7 of the SENE Regional Report, Marine Management*. That chapter covers in specific fashion: off-shore fisheries; shellfish and aquaculture; port development; dredged materials disposal; offshore sand and gravel; and urban waterfronts.

Additional marine related topics, such as recreational boating, beach swimming, coastal access, and salt water sportfishing can be found in *Chapter 6 of this Report or in the Regional Report*. Similarly, discussions on power plant siting, including coastal sites, and regional petroleum needs, including coastal implications for tank farms, can be found in *Chapter 9, Locating Key Facilities, of the Regional Report and in Chapter 9 of this report*.

SHELLFISH MANAGEMENT

The Situation

Management of the Cape and Islands shellfish resources is the responsibility of the individual communities. Because those communities with greater resources devote more time to conscientious management practices than those with lesser amounts of shellfish beds, inconsistencies and fragmentation develops between communities. In some cases, where municipalities cannot afford to hire trained personnel for the job, mismanagement and under-utilization results. Management of the resource might be more efficient if the Division of Marine Fisheries were provided with more personnel to provide technical assistance to these towns.

Although the existing shellfish resources are sufficient to meet recreational demands through 1990, it is necessary to import shellfish for the commercial and restaurant trades. This is especially true in the off-season when demands for shellfish production are highest. With extensive estuarine habitats scattered throughout the Cape and Islands, greater emphasis could be placed upon commercial shellfish production to supplement commercial digging operations.

Research on marine aquaculture has indicated that the species which are most suited to environmental conditions in the SENE region and which still make economic returns are: the American oyster (which has been cultured in varying degrees in this country for over a hundred years); the hard-shell clam (quahog); and the bay scallop. All are native to the area, all have been successfully cultured through every

life stage to market size, and all have considerable market value. Recent research has indicated that aquaculture can be economically feasible, but would require large land and water areas and monitoring of environmental impacts.

The Solutions

Because the availability of suitable coastal areas on both the Cape and the Islands is limited to protected embayments, intensive shellfish culture would have to be used for these waters in order to provide continual optimum conditions for growth and development. The following actions are recommended:

1. **Provide state technical assistance for local shellfish management.** Present local management of shellfish resources should be strengthened by funding the Massachusetts Division of Marine Fisheries to provide increased technical assistance to the towns. This could be partially paid for by requiring recreational shellfish licensing.

There are six farming zones in coastal environments: shore, intertidal, sublittoral, surface floating, mid-water, and seabed. Research has shown that preference should be placed on sites located in protected areas. Extensive culture operations require large land areas for ponds, whereas intensive culture demands dense propagation per unit area. Intensive culture would be used for these waters in order to provide continual optimum conditions for growth and development. Aquacultural operations can interfere with natural processes, and legislation in the Commonwealth addresses means of resolving this potential conflict. The following action is recommended:

2. **Study aquacultural potential of estuaries.** Consistent with SENE resource maps showing high quality estuaries (included in category A, see Chapter 3 and criteria listed in Chapter 7 of the Regional Report) the Division of Marine Fisheries should verify the suitability of: Cape Poge Bay and the series of ponds on Martha's Vineyard south shore, plus numerous others as feasible and appropriate. Any maintenance dredging required in these harbors should be timed to avoid conflict with aquacultural operations.
3. **Provide state assistance for local aquacultural licensing and management.** The state Division of Marine Fisheries should be funded to take a more

active role in providing technical assistance to communities in locating suitable sites, and evaluating private corporations for the necessary technical and administrative qualifications prior to granting aquacultural licenses.

4. Consider wastewater reuse for aquacultural operations. The state Department of Environmental Quality Engineering should consider re-vamping its regulations concerning shellfish beds to allow potential use of treated effluent for shellfish propagation, consistent with guidelines prepared by the Environmental Protection Agency.

As is described in *Chapter 7 of the Regional Report*, the shellfish industry is an important part of the SENE region's commercial fisheries and an important sector of the region's economy. Shellfish harvesting provides important local income and tax benefits to towns, as well. Implementation of these recommendations to increase availability of shellfish resources will help strengthen and stabilize the economies of many of the Cape and Islands communities. An improved-yield shellfish industry, supplemented by aquacultural production, could also stimulate local economies by providing a labor-intensive employment base and could increase the volume of shellfish available to the commercial trade.

CHAPTER 8 FLOODING AND EROSION

The coastal area along the Cape Cod and Islands planning area constitutes over a third of the Massachusetts coastal zone. This extensive coastal area represents a significant portion of the state's tourist economy, making coastal flood and erosion damages, particularly to the sandy beaches, especially important problems. Inland flooding problems are practically nonexistent due to the fact that the planning area has numerous small streams, moderate slope, and highly pervious soils. But coastal flooding is common, and related damages are rising as a result of increased development in flood prone areas.

In general, the Study's recommendations emphasize that both inland and coastal flood plain areas should be protected from development by using non-structural solutions such as maximum protection of wetlands and strict development criteria wherever possible. Only where there is high-value development in small concentrated areas should development be protected from flooding, coastal or otherwise, by using structural solutions. Recognition of the multiple values of wetlands — not just as natural flood retention areas, but for wildlife habitat, water supply, recreation, and landscape quality as well — further strengthens the importance of natural valley storage area protection as a means for reducing flood damages.

The Situation

Inland Flooding and Erosion

There are no significant flood problems in the non-tidal portions of the streams in the Cape Cod and Islands planning area. Damages from riverine flooding have been minimal in the past. The area's streams have small drainage areas in highly pervious soils. This fact, combined with the area's numerous ponds, lakes, cranberry bogs, and depressions and scattered inland wetlands furnish natural storage that tends to minimize flood flows and flood stages. These same storage areas provide recharge areas for ground water which serves as the principal source of municipal water supply throughout the Cape and Islands planning area. The Corps of Engineers, in approximating extents of major flood plains for all SENE planning areas, terms Cape Cod inland flood plains as "negligible".

There is a total of only about 11,500 acres of inland wetlands in this study area, the smallest absolute total of all SENE planning areas. Although inland wetlands are relatively few, lakes, ponds, and bogs raise the total of natural valley storage areas to some 23,500 acres. Towns having over 500 acres of inland wetlands include Sandwich, Barnstable, Dennis, Brewster, Harwich, Chatham, Wellfleet,

Truro, and Nantucket. In addition, there are approximately 12,000 acres of lakes and ponds, most of which are located on the Cape. Of this total, there are nearly 3,000 acres of cranberry bogs and tidal ponds.

The U. S. Geological Survey records flow rate at one stream gauging station within the Cape Cod and Islands area. Discharge records for Herring River at North Harwich have been published by the USGS since the gauge was established in June 1966.

Based on the limited flood data and stream gauge data available, it is estimated that the maximum rise in non-tidal stream levels during flood periods is generally 3 to 5 feet. Coincident high tides during fresh water flood periods may tend to aggravate inland flooding due to backwater effects, but no serious damages have been reported. While most existing buildings have been built at high enough elevations so that they have not been subject to flooding, problems could occur if residential and other developments are constructed without regard to previously experienced or potential flood heights.

Inland erosion is not a major problem in this planning area. General approaches to local inland erosion problems are discussed in *Chapter 8 of the Regional Report*.

Tidal Flooding and Coastal Erosion

The major coastal resources problems in this area are: continual coastal erosion, particularly of the erodible bluffs and sandy beaches; encroachment and misuse of marshlands; tidal flooding of low lands, with subsequent damage to private and public buildings; and indiscriminate development in the coastal region. Tidal flood plains have been estimated by the Corps of Engineers at some 8200 acres.

In addition to occasional hurricanes, a large number of other storms, such as extra-tropical storms and northeasters, occur in the area. The frequent winter northeaster can be stalled in the area for several days and cause above-normal tides and high waves over an extended period of time. During coastal storms, waves can cause severe coastal erosion of 5 to 30 feet in some areas; and tidal surges of over 14 feet can occur, inundating large areas of low lying land. The maximum hurricane tides recorded in the Study area were experienced during the Great Atlantic Hurricane of 1938. During this storm, tides rose 11.9 and 14.7 feet above mean sea level at West Falmouth Harbor and at Monument Beach in Bourne, respectively.

A 1963 report on coastal flooding in Barnstable County,

prepared for the Massachusetts Water Resources Commission, presents a description of the causes and effects of tidal flood waters on the shoreline and surrounding low lying areas. The findings of that study indicate a need for a more coordinated effort by the communities involved to determine procedures for adjusting existing and future development so as to provide adequate protection against the recurrence of severe damage caused by tidal flood action, such as occurred in 1954 when the damage on the south shore of the Cape alone amounted to over \$4 million.

The Corps of Engineers has estimated critical coastal erosion at nearly 292,000 feet per year, particularly along the area's 407 miles of sandy beaches (including 149 miles of recreational beaches) and 5.6 miles of sand and gravel bluffs. Critical erosion (3 feet or more per year) is occurring along beaches in Truro, Wellfleet, Eastham, Orleans, and parts of Chatham where one area has been identified by the Corps of Engineers as needing protection. There is also a critical erosion area needing protection in Barnstable, and two in Mashpee, and non-critical areas in Bourne and Falmouth. Southern areas of Nantucket are experiencing critical erosion; some noncritical erosion is occurring along the northern tip of the Island. The southern beaches of Martha's Vineyard and the bluffs of Gay Head have significant coastal erosion problems in addition to some non-critical areas along the Vineyard and Nantucket Sound shores of Edgartown, Oak Bluffs, Tisbury, West Tisbury, and Chilmark (*see Chapter 8 in the SENE Regional Report for a map of the critical erosion area*).

At the same time, sand accretion is occurring at several areas in Chatham, Barnstable, Orleans, Eastham, Wellfleet, Truro, and Provincetown on the Cape, in Edgartown on Martha's Vineyard, and in Nantucket.

A number of reports have been written by the Corps of Engineers and other agencies about shoreline conditions, coastal protection projects, and storm damage throughout the Cape and Islands. Federal shore protection projects authorized in the area include Thumpertown Beach, Provincetown Beach, and the Sandwich Town Neck Beach. Although these projects were adopted in July 1960 and modified by the River and Harbor Act of 1962, no work has been done on these projects due to lack of non-federal funding support.

The Thumpertown Beach Project provides for federal participation in the amount of 70 percent of the cost for widening 1600 feet of beach to a width of 125 feet by direct sand placement. The construction of four groins, ranging in length from 340 feet to 380 feet, and a 1200-foot concrete seawall are also included. Placement of sand shall be deferred until it is determined whether or not the groins will fill naturally.

The Sandwich Town Neck Beach Project provides for

federal participation in the amount of 50 percent of the cost for widening and the periodic nourishment of 6500 feet of beach to a width of 125 feet together with the entire cost of raising the inshore jetty of the Cape Cod Canal.

The Corps completed, in 1964, an interim hurricane survey of Massachusetts coastal and tidal areas. Complete hurricane flood protection was found to be impractical and uneconomical, due to the scattered nature of developments and potential damages and the recreational use of the beaches.

The Division Engineer recommended that no further federal improvements for hurricane protection be undertaken in Massachusetts at that time. However, the report was published with appendices for planning purposes to guide non-federal public and private interests in studies for the protection and development of lands, waters, and other natural resources in the coastal areas.

Much work has been done by local and state agencies to preserve and protect the existing beaches and coastal areas. Projects presently pending for the Division of Waterways, Massachusetts Department of Public Works (under the provisions of the General Laws of the Commonwealth of Massachusetts and as petitioned for by the various towns) include the following: shore protection at Red River Beach and Hardings Beach in Chatham; reconstruction of jetty at Shore Road in Harwich; construction of jetties at Sengekontacket Pond and repair of sea wall along Sea View Avenue in Oak Bluffs; reconstruction of stone groins at East Sandwich Beach and construction of stone groins in Sconton Creek area in Sandwich; repair of Herring River dike, repair of rip-rap and pilings of marina at Wellfleet Harbor and construction of East breakwater at East Bay in Barnstable.

Coastal wetlands act as buffer strips between the land and sea and, therefore, need to be protected in order to reduce future storm damages. The Cape and Islands area contains nearly 15,000 acres of coastal wetlands. These wetlands are located all along the coast, with large concentrations on the Bay end of Provincetown; around Wellfleet Harbor; behind Nauset Beach in Eastham, Orleans, and Chatham; along Cape Cod Bay in Eastham, Orleans, Brewster, Sandwich, Barnstable, Yarmouth, and Dennis; with smaller areas scattered along the south side of the Cape and around the Islands. A number of the coastal wetlands have been classified as unique natural areas; those not already protected in towns experiencing high and medium development pressure (*see Chapter 3*) should receive top priority for preservation.

The Solutions

A number of measures for reducing flooding and erosion damages were considered. These are discussed and evaluated in *Chapter 8 of the Regional Report*.

Recommendations

A major result of the SENE Study has been the classification of the region's resources according to their capability for development. Inland and coastal wetlands, estuaries, beaches, barrier beaches, and critical coastal erosion areas have been classified as 'A' resources, Priority Protection Areas, requiring the greatest degree of protection from development. Flood plains and hazardous coastal flooding areas (both to the 100-year flood frequency line) have been classified as 'B' resources, Other Protection Areas, which have very limited tolerance for development, but with proper management are suitable for such compatible activities as agriculture or recreation.

In keeping with these resource classifications, it has been recommended in the *Regional Report, Chapter 8*, that comprehensive flood plain management programs should be developed for flooding areas making use of non-structural solutions wherever possible. All such programs should be developed in close cooperation among federal and state agencies, regional planning agencies, and local governments and interests. They should also be coordinated with related programs, such as the National Flood Insurance Program, forecasting services of the National Weather Service, state wetlands acts, state land use planning programs, and state coastal zone management programs.

Section 73 of the Water Resources Development Act of 1974 authorizes federal cost sharing for non-structural measures. Although implementation of Section 73 has presently been deferred by the Office of Management and Budget (OMB) application of the cost sharing authority can be an important factor in making non-structural solutions more competitive than they have been. Thus, the Pilgrim Area Resource Conservation and Development project may be able to support non-structural as well as structural measures for alleviating storm and flood damages. The Soil Conservation Service in the U. S. Department of Agriculture is sponsoring the project in cooperation with other agencies. The project is locally initiated and directed and is designed to carry out a program of land conservation and land utilization, accelerated economic development and employment.

For the Cape Cod and Islands planning area, with short coastal streams almost entirely within single municipalities, a comprehensive program could be carried out on a municipal basis, unified through the state coastal zone management program and regional planning agency coordination.

Therefore, in the context described above:

1. **Adopt flood plain zoning to prevent adverse flood plain development.** Municipalities should adopt flood plain zoning to prevent adverse development in flood prone areas (and particularly in the

100-year floodway), as defined under the National Flood Insurance Program.

This also includes incorporating inland and coastal wetlands, eroding areas, and storms of record on the map upon which the zoning is based. HUD is considering new ways of delineating coastal storm hazard areas in order to make the mapping process and insurance rates more accurately reflect coastal conditions. All related regulations — building codes, subdivision regulations, sanitary codes — should reinforce this policy of preventing adverse development and redevelopment in the 100-year flood plain. The regulations should also take advantage of the restrictive provisions of state wetlands regulations, scenic rivers programs, and the like. As discussed in the *Regional Report, Chapter 8*, technical assistance should be provided to all officials responsible for enforcing the zoning and related regulations.

In conjunction with a zoning program:

2. **Acquire significant flood plains and wetlands.** Municipalities and state agencies should investigate continuing possibilities to acquire those wetlands and flood plain areas most significant for flood and storm damage reduction and protection, and which have water supply, wildlife, and/or recreation values.

Particular emphasis should be given to protection of areas classified as unique natural areas and those located in areas subject to high and medium development pressure. More specific actions regarding wetlands protection are included in *Chapter 8 of the Regional Report*.

In built-up and heavily used areas, alternative locations outside the flood plain may not be feasible.

3. **Locate in existing safe buildings in the flood plain.** Where location outside the flood plain is not feasible, municipalities should encourage private interests to locate in existing safe buildings on the flood plain, rather than permitting new construction on the flood plain.

Floodproofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities on a waterfront location need some degree of protection. Improved and expanded storm and flood forecasting and warning services, recommended in *Chapter 8 of the Regional Report*, will also be important in keeping down future damage costs.

In general, the Study has recommended accepting most coastal erosion, reflecting the philosophy of living with and adjusting to natural events and accepting the dynamic role

natural processes play in the long-term evolution of areas such as the Cape Cod National Seashore. This policy incorporates a new resource management policy pertaining to National Seashores which is being formulated by the National Park Service. The policy is designed to manage such areas to both serve present visitors and preserve these areas in essentially a natural state.

The *Regional Report, Chapter 8*, contained recommendations for including critical coastal erosion areas in 100-year coastal flood prone areas, and putting this entire coastal flooding zone under the jurisdiction of the state coastal zone management program.

On a local level, recommendation number 1 called for prohibiting development and other damaging uses of critical erosion areas through local flood plain zoning. In addition, municipalities should:

- 4. Encourage natural stabilization of coastal erosion areas.** Municipalities and conservation commissions should continue to encourage stabilization of coastal erosion areas, giving priority to areas experiencing critical rates of erosion (3 feet or more per year).

Use of vegetative cover, snow fences, discarded Christmas trees, and boardwalks have proven effective approaches to controlling accelerating rates of wind and wave erosion.

No specific sites have been identified for structural erosion control projects in this planning area. However, *Chapter 8 of the Regional Report* recommends selective construction of erosion control projects for areas other than beaches such as eroding bluffs (except for unique natural sites such as Gay Head). Artificial beach nourishment does not provide substantial benefits unless public recreational benefits are added in as well. Therefore, further discussion of the possibilities for beach nourishment are included in the *Outdoor Recreation Chapter of this report*. Any studies and projects should address the littoral drift relationships between beach erosion and headland protection.

Implications

This overall approach is a good deal more restrictive than the National Flood Insurance Program requires. But it does make full recognition of resource limitations and natural functions of wetland and flood plain areas. The SENE Study has found that all new development can be accommodated in C, F, and G lands (*Developable Areas as discussed in Chapter 3, Guiding Growth*), so that protecting A and B lands (*Critical Environmental Areas, Chapter 3*) from inappropriate use need not be incompatible with a growing economy. In fact, a policy of resource protection and non-structural solutions is regarded as a significant step toward protecting the physical beauty of the region's landscape, which is expected to be in the long-term interest of the SENE Region.

CHAPTER 9 LOCATING KEY FACILITIES

One of the most difficult subjects to grapple with at the local level is the siting and operation of such *key facilities* as power plants, sand and gravel pits, and solid waste disposal. Bluntly stated, they are unwelcome neighbors. At the same time, however, few people are willing to live with the consequences of not having enough of the vital products or services provided by these operations. On the Cape, the situation is further complicated by increasing competition from other potential users of the sites which are appropriate for these actions, not the least of which is recreational use. The new Massachusetts solid waste management program should be more than adequate to meet the needs of Cape Cod development and is strongly endorsed by the Study.

SAND AND GRAVEL EXTRACTION

Sand and gravel production in the Cape Cod and Islands planning area exceeded 400,000 tons in 1970. The only really extensive deposit is a belt about a mile and a half wide stretching roughly from Woods Hole in Falmouth northward for about 8 miles to East Sandwich. Most of the Cape's sand and gravel is produced at three plants in Falmouth and one near Hyannis. Other pit operations are located in North Truro and Sandwich on the Cape, and Nantucket and Edgartown on the Islands.

Chapter 3 of the Study's Regional Report indicates an exceedingly rapid rate of growth on the Cape, which has some of the region's largest sand and gravel deposits. Conflicts are inevitable and the Regional Report provides a series of recommendations designed to maximize extraction of local mineral resources at the least damage to the physical landscape, within the context of a state-assisted local sequential land use plan. These recommendations would provide statewide operating standards, wider local control and permitting procedures, state licensing of extraction

operators, and mandatory site rehabilitation. If implemented, they should be more than adequate for meeting the planning area's development needs, and yet guarantee minimum social and environmental disruption.

ELECTRICAL POWER

While there are several small peaking units scattered throughout the Cape and Islands, the only significant baseload generating station is located in Sandwich, on Cape Cod Canal. The first unit in the steam-electric generating plant was completed in 1968, and has an installed capacity of 542.5 megawatts. A second fossil unit, with a capacity of 560 megawatts, is being completed and is scheduled to be "on line" in July 1975. A third fossil-fueled unit is scheduled to be constructed near the same site. Current utility reports to the Federal Power Commission indicate a July 1982 installation date for the proposed 695 megawatt unit.

The existing complex capitalizes on the abundance of cooling water at the site and the relatively good availability of land. Current plans are in accord with the SENE Study's recommendation for maximum development or clustering at existing sites.

The Study's detailed recommendations on power in *Chapter 9 of the Regional Report* provide guidance on consumption reduction measures to minimize the need for additional generating capacity, and outline a series of specific steps for improving the process of power plant site selection. Implementation of these recommendations on a regional scale will be adequate to assure the rapidly growing population of the Cape adequate power for growth, consistent with the area's unusually attractive environment.

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